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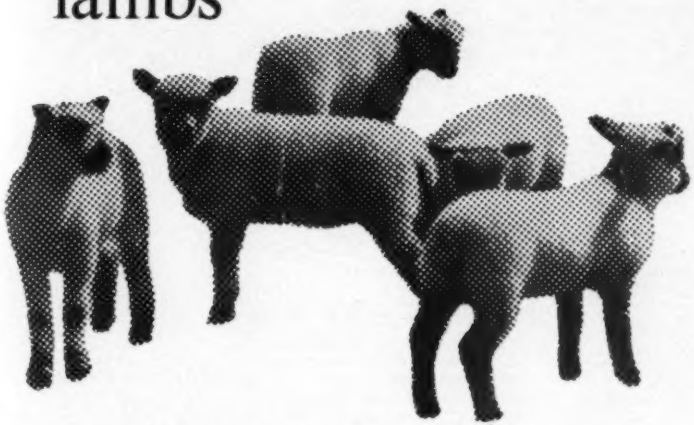

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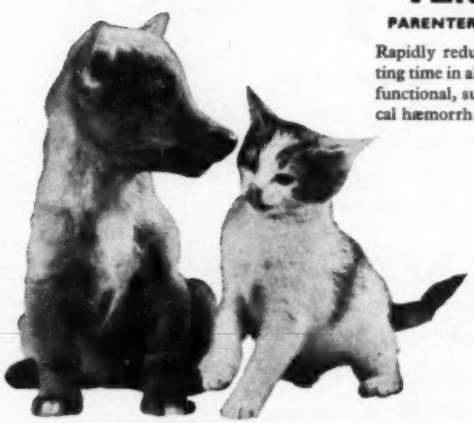

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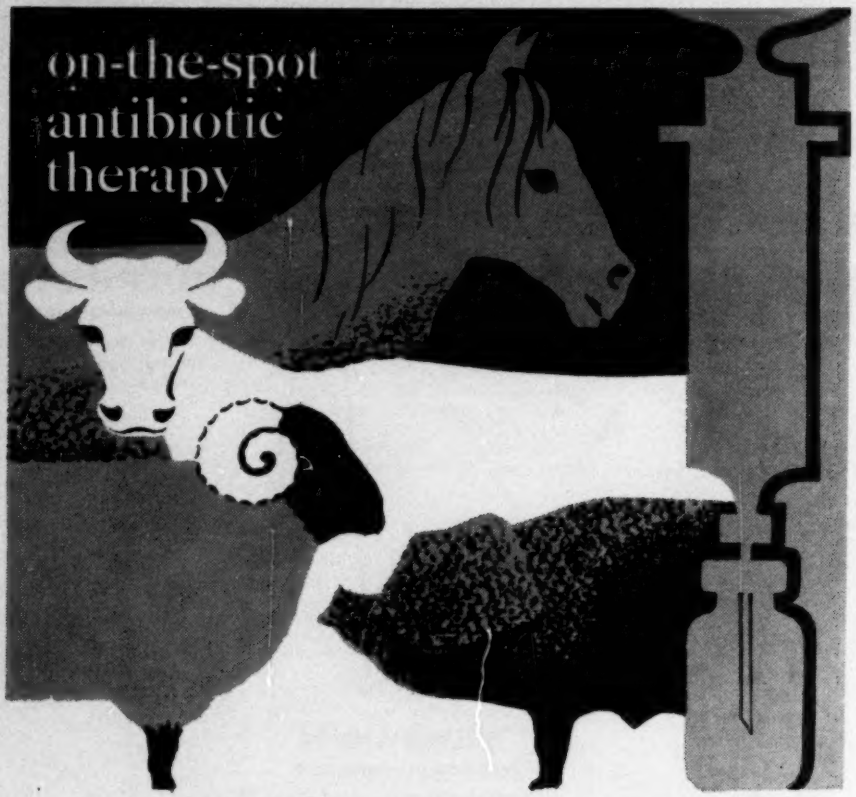

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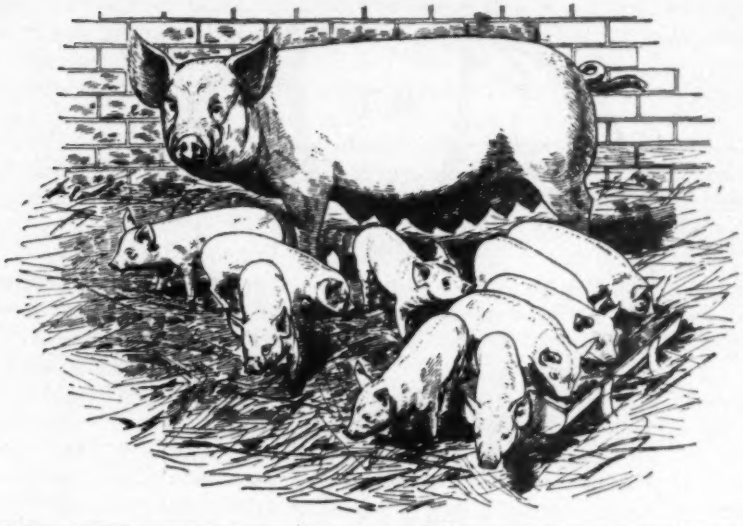

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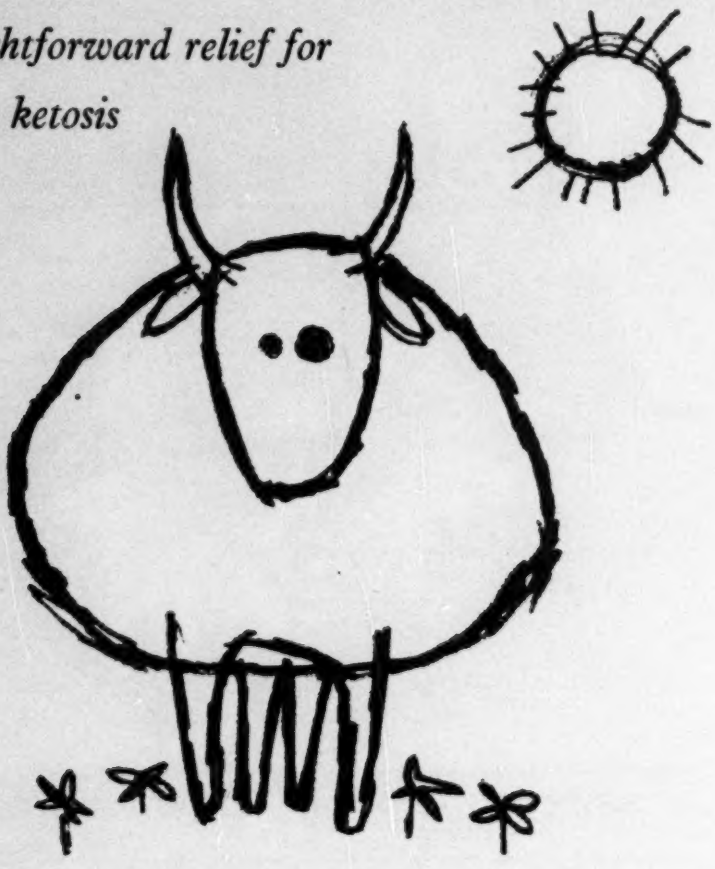

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Brit. vet. J. (1961), 117, 229

AFRICAN PIG DISEASE*

By T. M. Doyle
Central Veterinary Laboratory, Weybridge

In 1921 Montgomery described a virulent disease of pigs in Kenya and named it "East African swine fever". It was first diagnosed in 1910, but two earlier outbreaks had been observed.

Fifteen outbreaks occurred between 1910 and 1915; three were confirmed biologically and the history, symptoms and lesions of ten left no doubt that they were the same disease. Two outbreaks were reported in 1914 from what was then German East Africa. The German veterinary authorities stated that the disease had been seen among wild pigs and was probably spread by them. It was noted that in every outbreak in Kenya wart-hogs (*Phacochoerus* spp.) were numerous in the vicinity. The outbreaks were widely scattered and the movement of neither domestic pigs, pig products nor attendants could be incriminated. It was the practice on many farms to allow pigs free range during the day so that they came in contact, directly or indirectly, with wart-hogs grazing the same ground.

Steyn (1928) reported on an acute disease of pigs in the northern Transvaal. Farmers stated it was so deadly that breeding was impossible and that affected animals rarely recovered. It was more prevalent among pigs on free range than among those in sties. Large numbers of wart-hogs were present on infected farms. Steyn noted the striking similarity in the incubation period, symptoms and lesions of the Transvaal and the East African disease.

De Kock, Robinson & Keppel (1940) described outbreaks of disease among pigs on the Witwatersrand (Johannesburg) and in the Western Province of the Cape. Swine fever had occurred from time to time in the Western Province, but this disease was different. It was believed to be the same as that seen by Steyn in the Transvaal.

Donatien & Lestoquard (1940) described as "pig typhus" a virulent disease that occurred at the Pasteur Institute, Algiers. It was believed to have been introduced by a newly purchased pig. It killed 19 out of 20 pigs which were immune to swine fever. The incubation period, symptoms and lesions were similar to those of the East African and the Transvaal disease.

Conceicao (1947) established that a virus disease of pigs which had been present for many years in Angola was antigenically distinct from swine fever;

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* Under the title "African Pig Disease" *The Times* of September 12 1960, referred to an epidemic among pigs in Spain. The disease was believed to be the same as that described by Montgomery (1921) as East African swine fever, which is now recognized to be a separate entity. As this disease occurs in various parts of Africa and is immunologically distinct from swine fever, the original name is misleading. African pig disease would appear to be appropriate.

he considered it to be the same disease as that studied by Montgomery. Velho (1956) had seen in Angola chronic cases of the disease which lasted for 21 days or longer. He believed the virus had become modified from being endemic in the country.

Rebeiro *et al.* (1958) reported a virulent disease near Lisbon, Portugal. It was similar in all respects to the African disease. It killed pigs hyperimmunized against swine fever. In the Lisbon area 216 premises were infected; of 10,731 pigs 5,222 died and the remainder were slaughtered. Secondary outbreaks occurred in rural areas through infected swill. The disease was present in Portugal from April 1957 to January 1958; 16,457 premises were infected, 6,103 pigs died and 10,354 were slaughtered. The origin of the disease was not discovered, but as it first appeared near a port, ship's swill was a likely cause.

The Times of September 12, 1960 referred to an outbreak of "African pig disease" in Spain. It stated that thousands of pigs had died or had had to be slaughtered in the previous few months to combat an epidemic which first appeared in Badajoz province and later spread to Salamanca and Ciudad Real.

The Office International des Epizooties recorded 55 fresh outbreaks between June and August 1960 in Portugal; and 158 outbreaks in August 1960 in Spain (Anon., 1960).

The most important outbreaks were those in East Africa and the Northern Transvaal because they pointed to the wart-hog as the source of infection. There was no swine fever in East Africa (Walker, 1933) so there was no possibility of confusing African pig disease with it, and no question of swine fever having passed from domestic to wild pigs and having become enhanced by passage. The Northern Transvaal was far inland and there was little possibility of swine fever being introduced there by ship's swill (Geiger, 1937). In both areas wart-hogs were numerous and domestic pigs came into contact with them.

Geographical distribution. The disease has been reported from Kenya, South Africa, South-west Africa, Congo, Angola, Nyasaland, Northern Rhodesia, Mozambique, Senegal, Algiers, Portugal and Spain.

Filtration. The causal agent of the disease is a filterable virus (Montgomery, 1921; Steyn, 1928, 1932; Geiger, 1937; De Kock *et al.*, 1940; Donatien & Lestoquard, 1940).

SYMPTOMS

There is general agreement among the various authors on the symptoms exhibited. Montgomery (1921) noted: "There is extreme weakness of the loins and within 24 hours of the onset of symptoms there is difficulty in walking. Co-ordination of the fore-limbs remains, but the hind quarters sway involuntarily and in many cases the hind legs are dragged as in paresis. The temperature varies from 104°-107°F. Diarrhoea very rarely occurs. Cyanosis of the ears and thighs is observed, later the whole body is involved. Death almost

invariably occurs within 48 hours of the onset of symptoms, often with convulsions. In some cases the epizootic is ushered in by sudden deaths. Pigs of all ages and breeds are susceptible."

Steyn (1928) reported that diarrhoea, with blood-stained faeces, frequently occurred and that a mucopurulent nasal discharge also occurred and foam issued from the mouth. Walker (1933) noted that the faeces were firm and might be blood-stained. De Kock *et al.* (1940) saw blood-stained faeces and in some cases blood oozing from the nose and anus after death.

Rebeiro *et al.* (1958) stated that diarrhoea, with blood-stained faeces, frequently occurred and sometimes blood oozed from the anus, and that there was a mucopurulent nasal discharge. Walker (1933) and Steyn (1928) observed vomiting in some cases.

MORTALITY

The mortality rate from either artificial or natural infection is nearly 100 per cent. Montgomery (1921) mentioned that out of 1,366 naturally infected pigs 1,352 died (98·9 per cent).

ARTIFICIAL INFECTION

The disease can be transmitted by subcutaneous, intramuscular, intraperitoneal, intravenous and intracutaneous inoculation of virulent material; and by feeding, by infective faeces and urine, and by contact (Montgomery, 1921; Steyn, 1928, 1932; Geiger, 1937; De Kock *et al.*, 1940).

POST-MORTEM FINDINGS

The lesions of both African pig disease and acute swine fever are characteristic of a haemorrhagic septicaemia. They consist of petechiae, which occur on the membranes lining the thoracic and abdominal cavities, and on the contained organs. The lymphatic glands are enlarged and show on section either petechiae or an intense inflammation. Lesions are generally present in the cardiac portion of the stomach; in acute cases the normal colour is changed from pink to dark red or purple. The lesions of African pig disease are usually more severe than those of swine fever.

Spleen

Montgomery (1921) noted that the spleen in African pig disease was double the normal size; it was thickened, dark and firm. Capsular petechiae were present. Steyn (1928) observed marked *tumor splenis* with hyperplasia of the Malpighian bodies; it was difficult to scrape off the pulp. Walker (1933) stated that the spleen was swollen, with a reddish colour on section, the Malpighian bodies being prominent and slightly above the surface of the pulp.

Geiger (1937) found that in typical cases the spleen was two to six times greater than normal. Donatien & Lestoquard (1940) described a great increase in the size of spleen. The capsule tore easily and the pulp was black and friable. De Kock *et al.* (1940) stated that the spleen might show little or no change,

but usually it was swollen to a variable extent, occasionally reaching two or three times normal size.

Velho (1956) observed that when the course of the disease was longer than five days the spleen was two or three times the normal size; enlargement was particularly noticeable in artificially infected pigs. Rebeiro *et al.* (1958) described the spleen as being three or four times normal size, the capsule a dark blue colour and pulp very soft.

Contrary to these findings, De Tray (1957*a*) stated that *tumor splenis* rarely occurs: and Maurer, Griesemer and Jones (1958) found it in only 6 per cent of 83 artificially infected pigs.

Lungs

Montgomery (1921) found interlobular oedema in 50 per cent of cases. Steyn (1932) also mentioned interlobular oedema. Walker (1933) stated that there was sometimes marked hyperaemia and oedema with infiltration of the interlobular septa and Donatien & Lestoquard (1940) that the lungs were either normal or oedematous. De Kock *et al.* (1940) stated that there was little or no change in many cases and in others interlobular oedema was pronounced. Rebeiro *et al.* (1958) said that all cases showed serious involvement of the respiratory system with acute inflammation of the trachea and bronchial tubes and congestion and oedema of the lungs. Maurer *et al.* (1958) observed interlobular oedema in about 25 per cent of cases.

The lesions present in the stomach, kidneys, heart and intestines are similar to but usually more severe than those of swine fever, and are of no value for differential diagnosis.

HISTOPATHOLOGY

African pig disease

Brain: Walker (1933) found no perivascular cellular infiltration and no proliferation of the glia in African pig disease. Thomas (1940) stated there was no perivascular round-cell infiltration as described in swine fever. The blood vessels and capillaries of the brain show hyalinization of the walls and karyorrhexis of the endothelial linings, but this is most distinct and constant in the lymphatic glands. Thomas regarded the karyorrhexis of the nuclei of the large lymphocytes and monocytes of the spleen and lymph glands as being of diagnostic value. Maurer *et al.* (1958) observed perivascular infiltration in most cases of African pig disease, although only a few vessels might be affected. The effect of the virus on lymphocytes was severe and their destruction with karyorrhexis is seen in lymphocytic tissue. Maurer *et al.* (1958) confirmed that the most significant difference between swine fever and African pig disease is the karyorrhexis of lymphocytes in the African disease.

Swine fever

Brain: Seifried (1931) reported a more or less marked encephalomyelitis and meningitis in swine fever. The encephalomyelitis was characterized by a varying amount of vascular and perivascular infiltration with small leucocytes and mononuclear elements. There was proliferation of the glia. Seifried and

Cain (1932) considered that the diagnostic value of the encephalitis was limited as it occurred in only 60 to 80 per cent of cases. Helmboldt and Jungherr (1950) believed histological examination of the brain to be a valuable diagnostic aid in the detection of swine fever.

IMMUNITY

There is ample evidence that pigs immune to swine fever are susceptible to African pig disease, and swine fever immune serum does not protect domestic pigs against African pig disease virus (Montgomery, 1921; Geiger, 1937; De Kock *et al.* 1940; Donatien & Lestoquard, 1940).

Immune serum

Most attempts to produce immune serum have failed. Montgomery (1921) and Steyn (1928) failed to produce a protective serum from domestic pigs. Montgomery failed also with a wild pig (*Potomochoerus*) and Walker (1933) failed with a wart-hog. Walker succeeded in preparing two lots of sera from recovered domestic pigs. Both gave protection in doses of 0·2 to 1·0 ml. per pound body weight against the homologous virus. De Tray (1957*b*) found that sera from carrier pigs rarely have protective properties; but in two pigs which survived, antibodies were demonstrated for 27 and 33 days after exposure to infection.

Vaccines

Both De Kock *et al.* (1940) and Rebeiro *et al.* (1958) failed to protect pigs with crystal violet vaccine. Vaccines killed by chemical and physical methods have also been tried without success.

Serum-virus method

Walker (1933) prepared serum from domestic pigs, survivors from previous experiments, by the intraperitoneal injection of virus. The serum gave protection against inoculation with the homologous virus. The immunity persisted for between 192 and 283 days.

Immunity of recovered pigs

So few pigs recover that information on their resistance to reinfection is meagre. Montgomery (1921) tested 12 survivors of natural outbreaks and only one was immune. The others possessed a variable degree of resistance, but eventually all died of a chronic infection. According to Walker (1933) pigs which recover from either natural or artificial infection die when re-inoculated with the homologous virus. Steyn (1932) observed that affected pigs seldom recover, but those that do recover acquire considerable resistance, although they may have a second attack which is less severe than the first. Donatien & Lestoquard (1940) found that pigs which recovered were not resistant to reinfection. De Kock *et al.* (1940) re-inoculated such a pig with virus from a different source to that of the original inoculum and it showed no reaction.

De Tray (1957*b*) suggested that all pigs which survived became virus carriers, and these carriers were the only pigs capable of resisting re-inoculation.

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Cain (1932) considered that the diagnostic value of the encephalitis was limited as it occurred in only 60 to 80 per cent of cases. Helmboldt and Jungherr (1950) believed histological examination of the brain to be a valuable diagnostic aid in the detection of swine fever.

IMMUNITY

There is ample evidence that pigs immune to swine fever are susceptible to African pig disease, and swine fever immune serum does not protect domestic pigs against African pig disease virus (Montgomery, 1921; Geiger, 1937; De Kock *et al.* 1940; Donatien & Lestoquard, 1940).

Immune serum

Most attempts to produce immune serum have failed. Montgomery (1921) and Steyn (1928) failed to produce a protective serum from domestic pigs. Montgomery failed also with a wild pig (*Potomochoerus*) and Walker (1933) failed with a wart-hog. Walker succeeded in preparing two lots of sera from recovered domestic pigs. Both gave protection in doses of 0·2 to 1·0 ml. per pound body weight against the homologous virus. De Tray (1957*b*) found that sera from carrier pigs rarely have protective properties; but in two pigs which survived, antibodies were demonstrated for 27 and 33 days after exposure to infection.

Vaccines

Both De Kock *et al.* (1940) and Rebeiro *et al.* (1958) failed to protect pigs with crystal violet vaccine. Vaccines killed by chemical and physical methods have also been tried without success.

Serum-virus method

Walker (1933) prepared serum from domestic pigs, survivors from previous experiments, by the intraperitoneal injection of virus. The serum gave protection against inoculation with the homologous virus. The immunity persisted for between 192 and 283 days.

Immunity of recovered pigs

So few pigs recover that information on their resistance to reinfection is meagre. Montgomery (1921) tested 12 survivors of natural outbreaks and only one was immune. The others possessed a variable degree of resistance, but eventually all died of a chronic infection. According to Walker (1933) pigs which recover from either natural or artificial infection die when re-inoculated with the homologous virus. Steyn (1932) observed that affected pigs seldom recover, but those that do recover acquire considerable resistance, although they may have a second attack which is less severe than the first. Donatien & Lestoquard (1940) found that pigs which recovered were not resistant to reinfection. De Kock *et al.* (1940) re-inoculated such a pig with virus from a different source to that of the original inoculum and it showed no reaction.

De Tray (1957*b*) suggested that all pigs which survived became virus carriers, and these carriers were the only pigs capable of resisting re-inoculation.

Eight domestic pigs which survived for periods of 86 to 456 days after exposure had a persistent viraemia. De Tray considered that resistance to re-inoculation may depend on persistent infection (premunition) rather than on circulating antibodies. In a later report (1960) he modified this view in the light of recent findings. Serial passage of the Hinde strain of virus in kidney monolayer cultures reduced its virulence for pigs. A considerable percentage of pigs inoculated with the cultured virus survived. While most of the survivors harboured the virus, in a few of them viraemia was not demonstrated, but they resisted re-inoculation with the homologous virus.

VIROLOGY

Velho (1956) found that after more than one hundred pig passages the virus was infective in a dilution of 10^{-11}. It was slightly modified for pigs after 85 passages in rabbits: the incubation period was longer and a more chronic infection was induced. The attenuation was insufficient to render it suitable for immunization purposes.

McIntosh (1952) passaged the virus 12 times in 8-day-old embryonated eggs. Incubation was at 33°C. The embryos usually died on the seventh day of incubation. Egg material of the third and sixth passages induced typical African pig disease in pigs. Velho (1956) passaged the virus 24 times in embryonated eggs. The virulence was diminished for pigs and a chronic infection was induced, but the few animals that survived were not resistant to re-infection.

INFECTION OF STIES WITH AFRICAN PIG DISEASE VIRUS

Montgomery (1921) found that sties remain infective for three days, but not for five and a half days. Steyn (1928) confirmed this finding.

ABSENCE OF PLURALITY OF SWINE FEVER VIRUS STRAINS

A great deal of work has been carried out on swine fever virus in various countries and no evidence of plurality of strains has been found. Immune serum, irrespective of its country of origin, protects against all known strains of the virus. There is, therefore, no justification for referring to "European" or "American" swine fever.

Many strains of virus obtained from Europe, America and Britain have been tested at Weybridge and all proved immunologically indistinguishable.

Crystal violet vaccine prepared from Dutch, German, American and English viruses has protected against natural and artificial infection with swine fever.

Dale, Schoening, Cole, Henley & Zinobar (1951) found a virus in America which possessed unusual characteristics. Pigs already immunized with serum-virus were protected against the variant virus, but a number of susceptible pigs inoculated with it and with immune serum either reacted and recovered, or died, whereas pigs treated with standard virus and the same serum remained normal. By increasing the dose of serum the effect of the variant could

be reduced or eliminated. It was clearly a variant swine fever virus and not a new type. Lucas, Bouley, Paraf and Quinchom (1953) reported a variant virus which appeared to be similar to that found in America.

The infection in wild pigs

Montgomery (1921) stated that "the case against the wart-hog is largely circumstantial, but is in every way supported by the experimental and epidemiological evidence obtained."

During the outbreaks in 1910-21 and 1954 in Kenya, and in 1928 in the northern Transvaal, wart-hogs were numerous in the vicinity. Further circumstantial evidence incriminating the wart-hog is that with closer settlement, the destruction of vermin and the provision of pig-proof paddocks, the incidence of the disease has been considerably reduced.

Montgomery (1921) inoculated 20 Uganda bush pigs and one young wart-hog (No. 58) with African pig disease virus. None of the bush pigs reacted, but one harboured virus in the blood for five days. The wart-hog had an irregular temperature from the 5th to the 15th day and then returned to normal; blood drawn from it on the 6th, 9th, 13th and 17th days infected domestic pigs, while blood drawn on the 21st day was avirulent. A second wart-hog (No. 59), exposed by contact to the disease, died from lobar pneumonia on the 30th day. Its blood was non-infective on the 10th and 23rd days of contact.

A domestic pig in contact with two wart-hog virus carriers failed to contract infection. Infected wild pigs appeared incapable of disseminating the virus by contact, urine and faeces. Steyn (1932) proved by inoculation that three of four healthy wart-hogs from the northern Transvaal were virus carriers, whereas six wart-hogs from Zululand did not harbour the virus. De Kock *et al.* (1940) found six of eleven healthy wart-hogs in the northern Transvaal were carriers. De Tray (1957*b*) recovered virus from the blood of a wart-hog 54 days after inoculation. He confirmed that the disease was not readily transmitted by healthy wart-hog carriers to domestic pigs, although there was, however, one successful transmission. De Tray (1960) also reported the isolation of the virus from 17 of 80 healthy wart-hogs (21 per cent).

Montgomery (1921) suggested that in nature the disease is spread by the carnivorous habits of pigs, presumably by domestic pigs feeding on the carcases of infected wild pigs. Walker (1933) failed to transmit the disease by fleas and lice. He suggested that a winged insect may transmit it among wild pigs and and from wild pigs to domestic pigs. Hammond and De Tray (1955) thought vultures might carry infective material from dead wart-hogs to domestic pigs.

Domestic pigs as reservoirs of the virus

Steyn (1932) established that recovered pigs can harbour the virus in the blood for at least two months. De Kock *et al.* (1940) reported that six of ten pigs which recovered were virus carriers, in some cases for ten months. De Tray (1960) stated that domestic pigs that survive infection with virulent African pig disease virus remain carriers, probably for life.

Haemadsorption

Malmquist & Hay (1960) inoculated cultures of pig bone marrow and buffy coat cells (leucocytes) with African pig disease virus. The virus infected certain large granular cells and produced haemadsorption (the adherence of erythrocytes to the surfaces of infected cells) and a cytopathic effect. Immune serum inhibited the haemadsorption reaction, but not the cytopathic reaction, to a significant degree. The authors consider the reaction to be specific and that it can be used for the differentiation of African pig disease and swine fever viruses.

De Tray (1960) reported that the existence of type or strain differences has been proved by the haemadsorption-inhibition test. Haemadsorption by one type of virus was inhibited only by the homologous serum. Sera from survivor carriers of the Hinde strain inhibited haemadsorption by the Hinde virus, but not by other strains of African pig disease virus. Furthermore, serum from a survivor pig inhibited haemadsorption by the homologous virus, but failed to inhibit haemadsorption by another strain. Dale and Sonders (1960) failed to produce haemadsorption or a cytopathic effect in bone marrow cultures with swine fever virus.

DISCUSSION

African pig disease occurs naturally among wart-hogs in many parts of Africa. It has occasionally been observed to cause mortality among them, and healthy animals may be virus carriers. Domestic pigs contract infection from wart-hogs, but the method of transmission has not yet been determined. Swine fever was not present in East Africa during the years 1910-21 (Walker, 1933) when Montgomery studied African pig disease, so there can be no question of it being caused by swine fever virus enhanced by passage through wild pigs. African pig disease is different in many respects to swine fever. Pigs immune to swine fever are susceptible to African pig diseases and swine fever immune serum affords no protection against African pig disease virus.

The incubation period, symptoms and course of the two diseases are so similar that they are of little value for differential diagnosis: African pig disease is usually more uniformly acute and severe than swine fever. It is highly infectious and would appear to spread more rapidly than swine fever, but more evidence is required on this point.

The mortality in both diseases is nearly 100 per cent. In epidemics of acute swine fever there is a tendency for the mortality rate to drop gradually and for chronic cases to appear, and although chronic cases of African pig disease have so far been rare in most areas, some have been seen by Velho (1956) in Angola, where the disease is endemic.

Many authors (Montgomery, 1921; Steyn, 1928, 1932; Geiger, 1937; De Kock *et al.*, 1940; Donatien & Lestoquard, 1940) consider *tumor splenis* to be a characteristic lesion of African pig disease. In swine fever the spleen may or may not be slightly enlarged and haemorrhagic infarcts frequently occur on the borders. Interlobular oedema of the lungs is present in many cases of

African pig disease. It is not a lesion of swine fever, in which disease areas of consolidation are frequently present. There is now evidence that plurality of African pig disease virus strains occur, but there is no evidence of it in swine fever.

African pig disease virus has been grown in embryonated eggs; it became slightly attenuated but it was not suitable for the immunization of pigs. Many efforts have been made to grow swine fever virus in eggs, but with the exception of Fontanelli, Mesancè and D'Ascani (1959) no one has had any success.

African pig disease virus is highly virulent, but appears to be of low antigenicity. Velho (1956) estimated the minimum lethal dose to be about 10^{-11}, whereas Cole, Henley & Hubbard (1946) found that of swine fever to be between 10^{-6} and $2{\cdot}5 \times 10^{-6}$. Swine fever virus is on the contrary strongly antigenic, vaccines and immune serum can be easily prepared and pigs which recover are solidly immune. So far it has not been possible to prepare a satisfactory immune serum against African pig disease but it would be an advantage if one was available for diagnostic purposes.

Attempts to prepare vaccine have not so far been successful and there is little likelihood of any being produced in the immediate future. The evidence that plurality of strains occur will increase the difficulties of vaccination. Vaccination is, however, merely of academic interest to countries with established pig industries and would be worth consideration only if the disease got out of hand and became endemic.

African pig disease being a virulent infectious disease, "stamping out" is the obvious and most economic method of control. All affected and in-contact pigs should be slaughtered and burned or buried on the premises. Salvaging of apparently healthy in-contacts should be avoided as it would be likely to spread the infection; furthermore it is out of line with contemporary knowledge of disease control.

CONCLUSIONS

African pig disease is a separate entity, the symptoms and lesions of which resemble those of swine fever. It is immunologically distinct from swine fever.

The disease may be brought into Britain with overseas traffic. It is significant that both the Algiers and Portuguese outbreaks occurred near ports. The main danger of introduction would appear to be through infected pork or bacon scraps in ship's swill; food scraps from aeroplanes might also be a source of infection.

The recent widespread outbreaks in Portugal and Spain emphasize the dangers involved and the need for vigilance and for drastic control measures.

REFERENCES

ANON. (1960) *Bull. Off. int. Epiz.*, **53**, 1472.
COLE, C. G., HENLEY, R. R. and HUBBARD, R. D. (1946). *J. Amer. vet. med. Ass.*, **105**, 143.
CONCEICAO (1947). *Percuaria*, **1**, 217. Cited by Velho (1956).
DALE, C. N., SCHOENING, H. W., COLE, C. G., HENLEY, R. R. and ZINOBAR, M. R. (1951). *J. Amer. vet. med. Ass.*, **118**, 279.

DALE, C. M. and SONDERS, J. R. (1960). Cited by Malmquist and Hay (1960).
DE KOCK, G., ROBINSON, E. M. and KEPPEL, J. J. (1940). *Onderstepoort J. vet. Sci.*, **14**, 31.
DE TRAY, D. E. (1957*a*.) *Bull. epiz. Dis. Afr.*, **5**, 475.
DE TRAY, D. E. (1957*b*). *J. Amer. vet. med. Ass.*, **130**, 537.
DE TRAY, D. E. (1960). *Bull. epiz. Dis. Afr.*, **8**, 217.
DONATIEN, A., and LESTOQUARD, F. (1940). *Arch. Inst. Pasteur Alger.*, **18**, 1.
FONTANELLI, E., MESANCE, J. and D'ASCANI, E. (1959). *Zooprofilassi*, **14**, 467.
GEIGER, W. (1937). Thesis, Vet. High School, Hanover.
HAMMOND, R. A. and DE TRAY, D. E. (1955). *J. Amer. vet. med. Ass.*, **126**, 389.
HELMBOLDT, C. F. and JUNGHERR, E. L. (1950). *Amer. J. vet. Res.*, **11**, 41.
HELMBOLDT, C. F. and JUNGHERR, E. L. (1952). *Amer. J. vet. Res.*, **13**, 309.
LUCAS, A., BOULEY, G., PARAF, A. and QUINCHOM, C. (1953). *Rec. Méd. vét.*, **129**, 18.
MALMQUIST, W. A. and HAY, D. (1960). *Amer. J. vet. Res.*, **21**, 104.
MAURER, F. D., GRIESEMER, R. A. and JONES, T. C. (1958). *Amer. J. vet. Res.*, **19**, 513.
MCINTOSH, B. M. (1952). *J. S. Afr. vet. med. Ass.*, **23**, 217.
MONTGOMERY, R. E. (1921). *J. comp. Path.*, **34**, 159, 243.
REBEIRO, J. M., AZEVEDO, J. A., TEIXEIRA, M. J., FORTE, M. C., REBEIRO, A. M., NORONHRA, F. O., PEREIRA, C. G. and VIGARIO, J. D. (1958). *Bull. Off. int. Epiz.*, **50**, 516.
SEIFRIED, O. (1931) *J. exp. Med.*, **53**, 277.
SEIFRIED, O., and CAIN, C. B. (1932). *J. exp. Med.* **56**, 345.
STEYN, D. G. (1928). Rep. S. Afr. Dir. vet. Services, 13th and 14th Reps., 315.
STEYN, D. G. (1932). Rep. S. Afr. Dir. vet. Services, 18th Rep., 99.
THOMAS, A. D. (1940) Cited by De Kock *et al.* (1940).
VELHO, E. L. (1956). *Bull. Off. int. Epiz.*, **46**, 335.
WALKER, J. (1933). Thesis, Vet. Faculty, Zürich.

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FIELD TRIALS OF SOME ANTHELMINTICS ON SCOTTISH HILL EWES

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Previous papers on anthelmintic dosing of Scottish hill sheep have described trials on lambs (Parnell, Dunn, Mackintosh and Reeve, 1955*a*) on hoggs§ wintered on the hill (Parnell, Dunn and Reeve, 1955*b*,) and on those wintered in fields (Parnell and Dunn, 1960). This paper reports trials on hill ewes, numerically the most important group and one which offers considerable scope for strategic dosing.

The effects of dosing young sheep with anthelmintics can be measured by body or wool weights or both, by worm-egg counts, coupled with differentiation of the larvae, and by death rates. In trials on ewes, these and additional measurements (percentages of lambs born, of lambs reared and of their live weights) of the effects should be made, but some of the results may, at first sight, appear to be contradictory. It seems probable that the live weights of the lambs and ewes could give contradictory answers should dosing the ewes affect the weight and vigour of the lambs at or soon after birth, in which case the lambs could be expected to suckle with more or with less vigour, which in turn would affect the ewes' milk supply, which might subsequently affect the ewes' body weights. An extreme example is the difference between sheep which had and those which had not nursed lambs; 43 gimmers‖ which had not nursed lambs on farm C had an average weight 3·8 lb. heavier than those which had; the corresponding difference between 82 dry ewes and 151 nursing ewes was 3·5 lb.

Observations on Blackface and Cheviot gimmers and ewes had given detailed data on the seasonal variations in the worm-egg production of sheep on the hills of southern Scotland (Morgan and Sloan, 1947; Morgan, Parnell and Rayski, 1950) and on the sequence and levels of the infestations of the adult parasites (Morgan, Parnell and Rayski, 1951, 1952; Wilson, Morgan, Parnell and Rayski, 1953; Parnell, Rayski, Dunn and Mackintosh 1954; Paver, Parnell and Morgan, 1955).

Crofton (1949) had examined the seasonal changes in the numbers of infective larvae on hill grazings just south of the Border, and shown that they were most

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§ "Hogg" is the name used in Scotland for a sheep from when it is weaned until it is shorn, that is from about five to fourteen months old.
‖ "Gimmer" is the name by which young ewes are known from about fourteen to twenty-six months old.

plentiful in late summer. The dates selected for the strategic dosings in these trials were based on these data. However, the possible importance of histotropic stages being present was not taken into account.

In gimmers and in ewes the sequence of the infestations is the same, although in gimmers the levels are higher (Paver *et al*, 1955). Worm-egg production is at its lowest at the end and beginning of the year, and starts to rise in February or March. On hill farms, lambing begins in mid-April. Parturition, conditions which influence appetite, such as dental malformations, and other debilitating factors, including the severity of the preceding winter (Paver *et al*, 1955), all influence the levels of the worm-egg counts, but the average peak of worm-egg production is always in late May or early June. The peak occurs, therefore, when the lambs are nearly two months old, consuming considerable quantities of grass, and highly susceptible to worm infestations. It is, therefore, extremely important to forestall contamination of the pastures. Crofton (1958) has noted the same phenomenon on lowland farms.

During the next few months of the year the average of the worm-egg counts drops. In some sheep it increases slightly in late summer or early autumn, following the period at which Crofton (1949) found that infective trichostrongyle larvae tended to be most numerous on the hill pastures of Northumberland.

The late winter or early spring rise in worm-egg production is caused by an increase in the numbers of adult *Ostertagia* spp., *Trichostrongylus* spp., *Chabertia ovina* and *Oesophagostomum venulosum;* any increase in the numbers of *Haemonchus contortus* occurs later; the latter, however, is a species which is rare on many Scottish hill farms.

The autumn rise in worm-egg production is mainly composed of eggs of *Ostertagia* spp., *Trichostrongylus vitrinus* and *Trichostrongylus colubriformis*. It occurs slightly later than the rise reported by Crofton (1954) to occur at weaning in ewes in western England.

Bunostomum trigonocephalum is one of the most pathogenic species in Scottish hill sheep; it does not show marked seasonal fluctuations in numbers.

It is desirable, but not essential, that strategic dosing should coincide with the gathering of sheep for other purposes. The methods of hill sheep husbandry vary in detail from district to district, but the times of the main gatherings are fairly similar.

During the winter Scottish hill ewes live under conditions which cause them to lose weight (Morgan *et al.* 1951). It was considered important, therefore, to reduce the infestations in autumn although these were then light, with the dual object of assisting the ewes to put on weight before winter and reducing the worm burdens which they would have to carry during winter and pregnancy.

In the autumn, anthelmintic dosing may be undertaken at one of the routine gatherings.

The ewes are seldom gathered during winter, unless snow drives them down or they have to be dosed because of infestation with liver fluke (*Fasciola hepatica*). However, there is usually a routine gathering in late winter or early

spring which tends to take place rather earlier in southern Scotland than in the Highlands.

To counteract the "spring-rise" it was decided to dose the ewes in most trials at the gathering before lambing, in the expectation that this would reduce the worm-burden during that critical period and, if the effect persisted, that it would reduce contamination of the grazings and thus also benefit the lambs.

Lambing takes place on the hill on many Scottish hill farms, but if there are fenced fields some or all of the sheep may be lambed in them. When lambing is in fields it would be possible to dose the gimmers and ewes when they and their lambs were put back on to the hill in late April or early May. After lambing, the first gathering is late in May or in the first half of June.

MATERIAL AND METHODS

Sheep on seven farms were used in these trials. Farms A, B and C are in the southern uplands; farm D is near Cheviot and farm E is on the southern slopes of the Pentland Hills. Farms F and G are in Perthshire. All were stocked with Scotch Blackfaces, with the exception of D, which was stocked with Cheviots. The various programmes of dosage which were tried are set out in Table I.

TABLE I

THE DOSING PROGRAMMES USED

Times of dosing	*Anthelmintic*	*Farms used*	*Numbers dosed*		*Number of trials*
			gimmers	*ewes*	
Ewes and gimmers on hill pastures					
Autumn and before lambing	Phenothiazine	A, B, C, D, E	206	553	9
Autumn and before lambing	Phenothiazine*	D			
Autumn and after lambing	Phenothiazine*	B	40	148	2
Autumn and before lambing	Carbon tetrachloride preparation	E	58	168	2
4 weeks before lambing	Phenothiazine*	E	12	37	1
2 weeks before lambing	Phenothiazine	A	22	109	1
Soon after lambing	Phenothiazine*	F, G	0	57	2
Ewes in fields					
Autumn and before lambing	Phenothiazine*	A	0	18	1
Autumn	Nicotine-copper sulphate	A	0	17	1
After lambing	Phenothiazine*				
	TOTAL	7	338	1,107	19

* Dosed and undosed control sheep were grazing together.

Some of the inevitable difficulties of assessing the results of trials of this type on Scottish hill sheep have been discussed in a previous paper (Parnell *et al.*, 1955*b*). In most of these trials, one part of the flock was kept undosed as the controls and a further group on separate land was dosed. The exceptions were in the final trial on farm D (when the sheep were dosed with phenothiazine in the autumn and before lambing), in a trial on farm E (when the sheep were dosed with phenothiazine a month before lambing), in the two trials in

Perthshire (when the ewes were dosed after lambing), and in the ewes in the fields of farm A; in these trials the dosed and control sheep grazed the same ground. In most cases the environment of treated and control groups was therefore not identical, but neighbouring areas which were as similar as possible were used. Hoggs were also dosed so that in the area occupied by the ewes under treatment there were no undosed sheep, with the exception of the lambs born during the trials and the rams when they were with the flock for five or six weeks at the end of the year.

In the first trial with phenothiazine about 62 g. per sheep was given in the autumn and 52 g. in the spring; in subsequent trials with this anthelmintic about 40 g., or slightly over, was used, except at one pre-lambing dosing on farm C when only half that amount was given. The phenothiazine was given as a suspension in water and the weights given include the dispersal agent. No data on the purity or particle sizes of the phenothiazine are available.

In the trials with carbon tetrachloride preparation about 16 ml. was given to each sheep; this preparation contained 20 per cent carbon tetrachloride.

The commercial preparation of nicotine-copper sulphate contained 1 per cent nicotine sulphate, 1·6 per cent copper sulphate and a trace of cobalt; the dose was 60 ml.

In the autumn the sheep were usually dosed in the middle of October, but in one trial on farm C this took place in November; dosage was usually a week or two before lambing was due to start.

In the earlier trials worm-egg counts were considered to be the measure which would give most information. In this paper "other Strongyles" (O.S.) include all the strongyle eggs found in these sheep, with the exception of those of *Nematodirus* spp. *Nematodirus* spp. are seldom numerous in adult Scottish hill sheep, and *Strongyloides papillosus* is of little pathogenic importance to sheep on the hills; the egg counts of these two genera have, therefore, been ignored.

On farms A and B all the control sheep were individually numbered but the treated groups which were on neighbouring areas were not.

On farm C none of the sheep were numbered; the treated group was made up of samples from two areas, the animals in one of which received a mineral supplement.

On farm D all the sheep were individually numbered. Sheep in the area which, for earlier observations, appeared to be slightly more heavily infested than the others, were selected for dosing, and the neighbouring area, on which there were also cattle, was selected as the control.

On farm E where all the sheep were numbered the sheep in the group treated with carbon tetrachloride were slightly lighter than those in the control group and some were infested with *F. hepatica*. Those which received phenothiazine were slightly heavier than the members of the control group.

No sheep were numbered on farms F and G.

In the tables the arithmetic means of the worm-egg counts of the dosed and control sheep are given. The statistical significance of the differences in worm-egg counts was determined with transformed counts, using the transformation

$y = \log_{10}(x + 1)$, where x was the number of eggs in four cells of the McMaster worm-egg counting slide (Paver *et al.*, 1955).

RESULTS

Treatment in the autumn and before lambing

Tables II, III and V summarize the effects of dosing gimmers and ewes with phenothiazine or with carbon tetrachloride in the autumn and again shortly before the start of lambing.

TABLE II

GIMMERS AND EWES DOSED IN AUTUMN AND BEFORE LAMBING
EFFECT OF DOSAGE ON WORM-EGG COUNTS

	Drug used	*P*		CCl_4		*P (in fields)*
	Age of sheep	*G*	*E*	*G*	*E*	*E*
Eggs/gram in autumn	Treated					
	Controls	226	113	181	152	56
	No. of trials in which eggs/gram of	285	113	193	100	80
	treated sheep lower than controls	4	4	1	0	1
	No. of trials in which eggs/gram of treated sheep higher than controls	5	5	1	2	0
Eggs/gram in early winter	Treated	20	10	7	14	6
	Controls	41	17	15	22	7
	No. of trials in which eggs/gram of treated sheep lower than controls	9	7	2	2	1
	No. of trials in which eggs/gram of treated sheep higher than controls	0	2	0	0	0
Eggs/gram in early spring	Treated	118	89	59	44	28
	Controls	179	77	35	47	24
	No. of trials in which eggs/gram of treated sheep lower than controls	7	5	0	1	0
	No. of trials in which eggs/gram of treated sheep higher than controls	2	4	2	1	1
Eggs/gram in late spring	Treated	371	322	466	479	94
	Controls	468	451	241	408	818*
	No. of trials in which eggs/gram of treated sheep lower than controls	4	5	0	1	1
	No. of trials in which eggs/gram of treated sheep higher than controls	3	2	2	1	0
Eggs/gram in summer	Treated	296	197	476	275	22
	Controls	291	213	525	242	65
	No. of trials in which eggs/gram of treated sheep lower than controls	4	4	1	0	1
	No. of trials in which eggs/gram of treated sheep higher than controls	4	4	0	1	0

* Excluding one ewe the average of controls was 162 eggs/gram.
G = gimmers. *E* = ewes. *P* = phenothiazine. CCl_4 = carbon tetrachloride.

The effects of treatment on the O.S. egg counts a few weeks and a few months after dosing, on the body weights of the gimmers and ewes in early spring and at the end of the trials, on the body weights of their lambs at the end of the trials, on fleece weights and on lambing percentages, are set out there.

TABLE III

EFFECT OF DOSAGE ON BODY AND FLEECE WEIGHTS

	Drug used	*P*		CCl_4		*P (in fields)*
	Age of sheep	*G*	*E*	*G*	*E*	*E*
Body weights by early spring	Average difference in lb. between control and treated sheep	+2·2	−0·3	−0·5	+2·5	+1·0
	No. of sheep	75	247	60	177	18
	No. of trials showing comparative					
	(a) gain	3	2	1	1	1
	(b) loss	1	2	1	1	0
Body weights by end of trials	Average difference in lb. between control and treated sheep	+4·1	+1·8	+2·0	+3·4	+2·3
	No. of sheep	79	223	53	148	18
	No. of trials showing comparative					
	(a) gain	3	2	2	1	1
	(b) loss	3	2	0	1	0
	Difference in fleece wt. in oz. between control and treated sheep	+4·2	+5·0	+9·0	+6·2	−4·0
	No. of trials showing fleece weight					
	(a) heavier	4	4	2	2	0
	(b) lighter	2	2	0	0	1

G = gimmers. *E* = ewes. *P* = Phenothiazine. CCl_4 = carbon tetrachloride.

Not all these measurements were available for all the trials, but the tables show the numbers of sheep and trials on which the data are based.

Phenothiazine was given in ten trials to 777 sheep, including eighteen old ewes in fields, and carbon tetrachloride was given to 226 sheep in two trials, both on the same hill area.

In four of these trials worm-egg counts were made again in November about a month after the sheep had been drenched. At that time the average O.S. egg-count of the drenched gimmers was 29 g. and of the drenched ewes 25 g., the averages of the controls being 153 g. and 60 g. respectively; in all four trials the averages of the dosed sheep were lower than those of the undosed controls.

In two of these trials O.S. egg-counts were made in mid-winter; the average counts of both the treated gimmers and the ewes were 5 g. while those of the controls were 71 g. and 39 g. respectively.

These counts and Table II show that after the dosing with phenothiazine in autumn the worm-egg counts were reduced and remained low for a few months, but were increasing again before the pre-lambing dosing; in other words, the levels were lowered, but the normal pattern was maintained.

After the pre-lambing dosing with phenothiazine the O.S. egg-counts increased again within a few weeks. However, at the end of May or in early June the O.S. counts of the treated sheep continued to be lower in most trials than those of the control sheep, but only in two of the trials were the differences statistically significant; in one trial the worm-egg counts from the gimmers were significantly lower at the 5 per cent level and in another trial those of the ewes at the 0·1 per cent level.

By the middle of summer there were practically no differences between the O.S. counts of the dosed and the control sheep.

The differences in body weights were statistically significant slightly more frequently: the gimmers once in January at the 5 per cent level, once in May at the 1 per cent level; the differences between the ewes were significant once in June at 1 per cent and three times at the end of the trials, once at 5 per cent and twice at 1·0 per cent.

On farm C the addition of a complex mineral mixture significantly (at the 0·1 per cent level) increased the body weights of the treated gimmers and ewes compared with those of the controls by the end of the trials. This perhaps suggests that the sheep, at least on this farm, may have been limited in their production by a mineral deficiency. Unfortunately the combination of giving minerals and dosing with anthelmintics was not tested.

On farm D there was an additional undosed group of sheep in a more densely populated area where there were also numerous cattle; the weight differences between the gimmers at the end of the trial was significant in favour of the treated sheep at the 5 per cent level and of the ewes at 0·1 per cent; their fleece weight differences were also significantly greater at the 0·1 per cent level.

The increased fleece weights of the gimmers drenched with phenothiazine were statistically significant once at 1 per cent and those of the ewes once at 5 per cent and once at 1 per cent.

In the second of the trials in which carbon tetrachloride was used the body-weight difference was significant at 1·0 per cent at the end of the trial. In these trials the autumn dosing gave an advantage of some 5 lb. by January, but Table III shows that by spring the difference had been reduced.

In three of the trials with phenothiazine the lamb weights were significantly heavier (Table IV), in one at the 1 per cent level and in two at 5 per cent, one of which was the trial in fields.

In both the trials the lambs of the sheep which were dosed with carbon tetrachloride were lighter than those of the controls (Table IV); in one trial the

TABLE IV

EFFECT OF DOSAGE ON NUMBERS AND GROWTH RATE OF LAMBS REARED

Drug used	*P*		CCl_4		*P (in fields)*
Age of sheep	*G*	*E*	*G*	*E*	*E*
Difference between control and treated sheep					
(a) in percentage which reared lambs	+0·5*	−3·0*	+5·0	−0·3	−16·7*
(b) in average lamb weights (lb.)	+2·0		−3·1		+3·6
Trials in which lambs from treated ewes were					
(a) heavier than controls	6		0		1
(b) within ½ lb. of controls	2		0		0
(c) lighter than controls	1		2		0
Number of lambs	447		188		18

* A higher proportion of the dosed than of the control sheep reared twins.
G = gimmers. *E* = ewes. *P* = phenothiazine. CCl_4 = carbon tetrachloride.

difference was significant at 0·1 per cent. Although at the start of the trial the drenched gimmers and ewes averaged 4·7 lb. and 3·7 lb lighter than the undrenched controls, this difference in the dams' body weights was probably insufficient to account for the difference of 3 lb. in the body weights of their lambs.

TABLE Va

GIMMERS AND EWES DOSED IN AUTUMN AND AFTER LAMBING

	Drug used	*P*		*NC (autumn) P(spring) in fields*
	Age of sheep	*G*	*E*	*E*
Eggs/gram in autumn	Treated	107	93	12
	Controls	294	109	80
	No. of trials in which eggs/gram of treated sheep lower than controls	2	2	1
	No. of trials in which eggs/gram of treated sheep higher than controls	0	0	0
Eggs/gram in early winter	Treated	22	6	9
	Controls	43	10	7
	No. of trials in which eggs/gram of treated sheep lower than controls	2	2	0
	No. of trials in which eggs/gram of treated sheep higher than controls	0	0	1
Eggs/gram in early spring	Treated	162	143	130
	Controls	423	155	140
	No. of trials in which eggs/gram of treated sheep lower than controls	2	1	1
	No. of trials in which eggs/gram of treated sheep higher than controls	0	1	0
Eggs/gram in late spring	Treated	407	275	69
	Controls	690	479	818*
	No. of trials in which eggs/gram of treated sheep lower than controls	2	2	1
	No. of trials in which eggs/gram of treated sheep higher than controls	0	0	0
Eggs/gram in summer	Treated	120	81	3
	Controls	287	136	65
	No. of trials in which eggs/gram of treated sheep lower than controls	2	2	1
	No. of trials in which eggs/gram of treated sheep higher than controls	0	0	0

* Excluding one ewe the average of the controls was 162 eggs/gram.
P = phenothiazine. *NC* = nicotine-copper sulphate. *G* = gimmers. *E* = ewes.

Autumn and post-lambing drenching

Table V summarizes the effects of dosing with phenothiazine in the autumn and after lambing, and of drenching some old ewes on in-bye fields with nicotine-copper sulphate in the autumn and phenothiazine after lambing.

The pattern of the worm-egg counts during the winter was similar, of course, to those shown in Table II, but before the sheep were dosed again the O.S. egg counts had risen considerably.

The only measurements which were statistically significant in this table were from one trial with phenothiazine, in which the body weights of the ewes

TABLE Vb

EFFECT OF DOSAGE ON BODY AND FLEECE WEIGHTS

	Drug used	*P*		*NC(autumn) P(spring) in fields*
	Age of sheep	*G*	*E*	*E*
Body weights by early spring	Average difference in lb. between control and treated sheep	−0·5	—	+0·6
	No. of sheep	22	—	17
	No. of sheep showing comparative			
	(a) gain	0	—	1
	(b) loss	1	—	0
Body weights by end of trials	Average difference in lb. between control and treated sheep	−1·4	+1·9	+2·9
	No. of sheep	30	106	17
	No. of trials showing comparative			
	(a) gain	0	2	1
	(b) loss	2	0	0
	Difference in fleece wt. in oz. between control and treated sheep	+6·3		+3·0
	No. of trials showing fleece wt.			
	(a) heavier	1		1
	(b) lighter	0		0

NC = nicotine-copper sulphate. *P* = phenothiazine. *G* = gimmers. *E* = ewes.

TABLE Vc

EFFECT OF DOSAGE ON NUMBERS AND GROWTH RATE OF LAMBS REARED

Drug used	*P*		*NC(autumn) P(spring) in fields*
Age of sheep	*G*	*E*	*E*
Difference between control and treated sheep			
(a) In percentage which reared lambs	+3·1	−2·5	−11·8*
(b) In average lamb weights (lb.)	−2·7		−3·8
Trials in which lambs from treated ewes were			
(a) Heavier than controls	0		0
(b) Lighter than controls	2		1

* A higher proportion of the dosed than of the control sheep reared twins.
NC = nicotine-copper sulphate. *P* = phenothiazine. *G* = gimmers. *E* = ewes.

were significantly heavier at the end of the trial and the lamb weights were significantly lighter, both at the 5 per cent level; the former suggests that dosing had been beneficial, the latter that it had not. In the three trials the lamb weights of the dosed sheep were lighter than those of the undosed control sheep.

The fleece weights of the drenched sheep were heavier than those of the undosed sheep.

Pre- or post-lambing dosing with phenothiazine

Tables VIa, b and c give the results of dosing with phenothiazine a month before the start of lambing, a fortnight before and about three weeks after.

The only statistically significant effect—at 5 per cent—was a reduction in one trial in the worm-egg counts of the ewes dosed after lambing when counts

TABLE VIB

GIMMERS AND EWES DOSED WITH PHENOTHIAZINE BEFORE OR AFTER LAMBING: EFFECT OF DOSAGE ON WORM-EGG COUNTS

	Time of dosing	*4 weeks before lambing*		*2 weeks before lambing*		*3 weeks after lambing*
	Age of sheep	*G*	*E*	*G*	*E*	*E*
Eggs/gram in mid-March	Treated	17	49	—	—	—
	Controls	25	51	—	—	—
	No. of trials in which eggs/gram of treated sheep lower than controls	1	1	—	—	—
	No. of trials in which eggs/gram of treated sheep higher than controls	0	0	—	—	—
Eggs/gram in early spring	Treated	17	34	16	27	—
	Controls	29	33	31	18	—
	No. of trials in which eggs/gram of treated sheep lower than controls	1	0	1	0	—
	No. of trials in which eggs/gram of treated sheep higher than controls	0	1	0	1	—
Eggs/gram in early May	Treated	—	—	—	—	717
	No control observations					
Eggs/gram in late spring	Treated	477	231	257	237	—
	Controls	406	577	392	420	—
	No. of trials in which eggs/gram of treated sheep lower than controls	0	1	1	1	—
	No. of trials in which eggs/gram of treated sheep higher than controls	1	0	0	0	—
Eggs/gram in summer	Treated	—	—	61	108	177
	Controls	—	—	100	89	532
	No. of trials in which eggs/gram of treated sheep lower than controls	—	—	1	0	1
	No. of trials in which eggs/gram of treated sheep higher than controls	—	—	0	1	0

G = gimmers. *E* = ewes.

were made ten weeks later. It did not affect the worm-egg counts of their lambs, but these were grazing with other ewes and lambs which had not been dosed.

Larvae from cultures

Larval identifications were only completed from the trials on farms A and E. The counts from cultures made from sheep of different age groups were pooled.

Seasonal differences were more marked than any differences between dosed and control sheep.

On the farm on the Pentland Hills in January, about three months after the autumn dosing with phenothiazine and with carbon tetrachloride, the proportions of *Ostertagia* spp. had increased in both dosed and control sheep.

There were insufficient larvae of *Bunostomum trigonocephalum* to determine whether autumn dosing with either phenothiazine or carbon tetrachloride reduced the numbers of this species during the succeeding winter.

By early summer, almost three months after the pre-lambing dosings, the percentages and numbers of *Ostertagia* spp. and of *H. contortus* had increased.

TABLE VIb

EFFECT OF DOSAGE ON BODY WEIGHT AND ON NUMBER OF LAMBS REARED

Time of dosing	*4 weeks before lambing*		*2 weeks before lambing*		*3 weeks after lambing*
Age of sheep	*G*	*E*	*G*	*E*	*E*
Body weight difference between control and treated sheep 2½ weeks later	+3·2	−2·6	—	—	—
No. of sheep	13	36	—	—	—
No. of trials showing comparative					
(a) gain	1	1	—	—	—
(b) loss	0	0	—	—	—
Body weight differences between control and treated sheep by end of trial	−3·3	−4·4	−4·2	—	—
No. of sheep	13	38	22	—	—
No. of trials showing comparative					
(a) gain	0	0	0	—	—
(b) loss	1	1	1	—	—
Difference in percentage which reared lambs	0	+3·2*	+3·8	+1·2	—

* A higher proportion of the dosed than of the control sheep reared twins.
G = gimmers. *E* = ewes.

TABLE VIc

EFFECT OF DOSAGE ON NUMBERS AND GROWTH RATE OF LAMBS REARED

Time of dosing	*4 weeks before lambing*		*2 weeks before lambing*		*3 weeks after lambing*
Age of sheep	*G*	*E*	*G*	*E*	*E*
Difference between control and treated sheep					
(a) In fleece weight in oz.	+2·6	+5·8	−5·0	+0·2	—
(b) In average lamb weight in lb.	+0·7		+4·7		+0·5
Trials in which lambs from treated ewes were					
(a) heavier than controls	1		1		1
(b) Lighter than controls	0		0		1
Number of lambs	34		114		44

G = gimmers. *E* = ewes.

The numbers of *Oesophagostomum venulosum* larvae were unusually high.

In the ewes in the fields of farm A *Ostertagia* was the dominant genus. The larvae of *Oe. venulosum* averaged 7 per cent of the total.

Body weights

It will be seen from Tables III and V that although treatment in autumn and spring did not increase the body weights of the gimmers and ewes in all cases, it did so by the end of the trial in many of them. The overall average increase over that of the controls was 2·35 lb. However, in the few trials in which the sheep were dosed only before lambing there was a relative loss of body weight by the end of the trials.

Fleece weights

The average fleece weights from 1,025 dosed hill gimmers and ewes were 4·6 oz. heavier than those of the control sheep. In the trials which included autumn dosing the gain averaged almost 5½ oz.

Considering the fleece weights of gimmers as a separate "trial" to the fleece weights of the ewes, the average weights of the fleeces of the dosed sheep were heavier than those of the controls in 17 and lighter than those of the controls in six trials.

Proportion of sheep which reared lambs

Tables II to VI show the differences in the percentages of treated and control sheep which reared lambs. In the majority of these trials the number of barren sheep was so small that no significance can be given to the percentage of sheep which failed to raise lambs in individual trials. In all the trials, except the two which involved dosing only after lambing and of the sheep in fields, 158 out of 1,233 dosed gimmers and ewes, and 110 out of 887 control sheep, failed to rear lambs, a difference of under 0·5 per cent. Most of the cases of failure to rear lambs occurred in 1951; in one trial none of 18 control gimmers reared a lamb and only four out of 22 dosed gimmers did so.

In the area where the sheep had access to minerals, an average of 66 per cent of the gimmers and ewes reared lambs; 59 per cent of the treated group and 53 per cent of the controls reared lambs.

Lamb weights

In over half the trials (Tables IV, V and VI), the average weights of the lambs reared by treated sheep were heavier than those reared by the untreated controls. In these tables the lambs reared by gimmers have been grouped with those reared by ewes, although the former tend to be lighter. A few twin lambs have also been included, although they also are often lighter; in the two trials, in which they were most numerous, 15 out of 167 treated ewes and four out of 81 untreated control ewes nursed twins.

The average weights of 936 hill lambs reared by treated sheep were about 10 oz. heavier than the lambs reared by the control sheep; however, if the 188 lambs reared by sheep which were treated with carbon tetrachloride are excluded the average increase is just over 1·5 lb.

Ewes in fields

These ewes were weighed more often than is shown in Tables III and V. About a month after each dosing their weight changes were less satisfactory than those of the controls, but subsequently these recovered completely. Lambing commenced in late March.

DISCUSSION

In this series of papers it has been necessary to consider the different age groups —lambs, hoggs, and gimmers and ewes—separately, but in practice all age

groups should be included in a comprehensive programme of treatment, so that the beneficial effects may be cumulative.

Strategic programmes of the treatment of Scottish hill gimmers and ewes should be planned to reduce the autumn infestations, including those of *B. trigonocephalum*, so that the sheep improve in condition as much as possible before they suffer the hardships of winter and of pregnancy, and so that the detrimental effect of even the light infestation of adult worms which they carry in winter, when the nutritional value of grazing is very low, may be avoided.

These trials were planned against adult infestations, because it was considered that immature histotropic stages were not numerous. It has, however, been observed in southern Western Australia, where the summer drought has a somewhat similar effect on the feed and on the sheep as has winter on Scottish hill grasses and sheep, that hoggs born in autumn enter the summer carrying very heavy infestations of immature stages in the walls of the abomasum and to a less extent, in the small intestine (Parnell, 1960). Scottish hill sheep were examined for histotropic stages and only a few were found, but it seems probable that the technique used at the time was inadequate (Morgan *et al.*, 1951, 1952; Wilson *et al.*, 1953; Parnell, 1954). If this is so, and if treatment can reduce the numbers of these stages in the late autumn, the pattern of the spring treatment might have to be revised.

No gimmers or ewes were treated during early winter because their worm-egg and adult worm counts were always low at that time. Hoggs whose infestation levels were also fairly low, but higher than those of gimmers and ewes, were treated then, however, and the treatment appeared to have some effect. It is possible, therefore, especially if treatment in winter had removed any immature stages, that treatment of gimmers and ewes in early winter might also be beneficial.

The timing of the late winter or spring programmes of treatment should aim to avoid both an extra gathering and also treatment too short a time before the start of lambing. Furthermore, treatment should be early enough to prevent the spring increase in the infestations from harming gimmers and ewes in late March and early April, which is the time when most deaths from starvation occur in Scottish hill sheep. These considerations must be reconciled with the fact that treatment should also be aimed at preventing the heavy infestations which occur in April and May, which may reduce the milk yields of gimmers and ewes and be a source of contamination for the lambs. In these trials this was attempted with one treatment in the spring, but two may be necessary.

Treatment both before and after lambing was not attempted in these trials. During the lambing period on a hill farm it is almost impossible to dose ewes unless they are being lambed near the farm buildings, in which case they can be treated as they and their lambs are drafted back on to the hill. Moreover, the data in Table V suggest that more trials which include treatment after lambing are required before this can be recommended, as from the few trials detailed in that table it would seem that this had an adverse effect on

the lamb weights. Gordon (1953, personal communication) has noted that phenothiazine given to ewes may reduce the weight gain of their suckling lambs, and in a large-scale trial with phenothiazine on young merino ewes in Western Australia Gardiner and Lefroy (1960, personal communication) have observed the same tendency.

Phenothiazine was the anthelmintic used in most of these trials, because it was the most effective one available against *Ostertagia* spp. and *Trichostrongylus* spp. No consideration was given to the necessity for a high degree of purity and fine particle size (Gordon, 1940, 1956; Foster, 1955; Whitten, 1956, 1958; Thomas and Elliott, 1957; Kingsbury, 1958; Douglas, Baker and Longhurst, 1956, 1959; Forsyth, 1959; Baker, Allen, Longhurst and Douglas, 1959) and no data are available on either the degrees of fineness or purity of the phenothiazine preparations which were used.

Better weight gains might have been obtained if an anthelmintic with the same or greater efficiency had been available which did not tend to cause the loss of body weight which may follow dosing with phenothiazine (Gordon, 1953, personal communication; Anon, 1954). This probably occurred when Scottish hill lambs were treated in a previous experiment (Parnell *et al.*, 1955*a*) and it also appears to have occurred in some of these trials. Such an effect might account for some of the contradictory results, some of them statistically significant, if it is assumed that, when infestations are heavy, treatment would increase productivity, while when they are light it may be positively harmful. It must, however, be pointed out that Leiper and Peters (1941) using phenothiazine, observed no adverse effect on the weights of worm-free sheep.

In the present series of trials no autumn treatment was given before mid-October. Earlier treatment might be advantageous, if there were no risk of immediate reinfection, since ewes would have a longer period in which to take advantage of the remainder of the grazing season.

It appears from these trials that, when the sheep were dosed during a period in which the worm-egg count normally declines, the difference between the O.S. egg-count of the treated and untreated control sheep was maintained for some months, but that when the sheep were dosed while the worm-egg counts were rising the difference in the counts disappeared more rapidly.

By summer, when these trials ended, the average increased gain in weight of the treated compared with the untreated sheep was just over 1½ lb. and the average increase of those treated both in the autumn and before lambing was about 1 lb. more than the overall average. The value of this gain in breeding sheep is difficult to assess.

After a severe winter there are many sheep, gimmers especially, which are so lean that they are unable to nurse lambs. In these trials the difference in the numbers of treated and of control sheep which failed to rear lambs was very small, 12·8 per cent compared with 12·4 per cent respectively.

Abortion, stillborn and weak lambs have been reported after treatment with phenothiazine (Hungerford and Howe, 1956; Warwick, Turk and Berry, 1946; Moule and Jackson, 1949; Harwood, 1953). In the trials

described in this paper sporadic occurrences of this sort might not have been attributed to the effect of dosing or might have escaped notice. It is, therefore, a matter for speculation whether treatment increased the number of sheep which had sufficient milk to rear lambs, but at the same time reduced the number of newborn lambs which lived. The fact that treatment benefited the gimmers slightly more than the ewes perhaps supports the view that this may be so. Gordon (1953) recommended that any anthelmintic treatment should take place at least a month before lambing to reduce the risk of precipitating hypocalcaemia or pregnancy toxaemia. There have been several small trials with phenothiazine in which pregnant ewes were not harmed (Haberman, Foster and Hummon, 1942). In large-scale trials in the West of Scotland (Anon, 1955) in which ewes were dosed with phenothiazine from several weeks to a fortnight before lambing no abortions or still-births were recorded. Since the typical increase in worm-egg production which occurs in the spring was observed and treatment trials were started it has become routine practice on some farms in southern Scotland to treat sheep with phenothiazine before lambing. This has involved many thousands of gimmers and ewes.

In a previous paper (Parnell *et al*, 1955*b*) it was shown that on one Border farm the lamb production had increased by an average of about 12 per cent since a programme of treatment for all age groups was started in 1948. The increased lambing percentages on that farm may, perhaps, be accounted for in part by the fact that all ages were dosed, and that treating the hoggs may have assisted their growth and made them more efficient as breeding sheep.

One of the most important factors affecting the size and weight of lambs is the milk production of the dam, which in turn is affected by her own physical condition at parturition and by the vigour with which she is suckled while the lamb is young.

In these trials treatment resulted in an overall increase in lamb weights of slightly more than 10 oz. However, in the trials in which phenothiazine was given in autumn and before lambing the increase was 2·0 lb. Apart from this immediate meat value the better physical condition implied by the extra weight might mean that a larger proportion of the wether lambs were suitable for slaughter without any additional fattening and were therefore correspondingly more valuable, and that the ewe lambs would make better stock.

Carbon tetrachloride was only used in two trials, both in the same area. In both trials it was given to the gimmers and ewes in the autumn and before lambing, and in both trials the lambs were considerably lighter than the controls.

Fleece weights and the condition of the wool are an extremely valuable guide to the health of the sheep during the time the fleece has been growing. In these trials no notes were made on the percentages of sheep with abnormal wool, but fleece weights were obtained in most trials, and if severe abnormalities were present they would result in part of the fleece being lost. In these trials the average increase in fleece weights was nearly 5 oz., or over 6 per cent. Those species of worms which cause diarrhoea are an additional

cause of loss when soiled wool has to be clipped off and on Scottish hills *Trichostrongylus* spp. is the usual cause, especially in young sheep.

The results of these trials suggest that treatment of breeding gimmers and ewes with phenothiazine in the autumn and before lambing could be expected to result in heavier sheep and fleeces in southern Scotland. The trials were, however, insufficient for it to be certain that this is the best practicable programme. Nor were sufficient sheep dosed with phenothiazine before lambing to be sure that percentages of lambs reared might not be reduced under some conditions, as has occasionally been reported from other countries.

SUMMARY

When Scottish hill gimmers and ewes were drenched with about 40 g. phenothiazine in the autumn their "other Strongyles" (O.S.) egg-counts were even lower than those of untreated control sheep in December and January when worm-egg counts are normally low. They rose again in mid-winter and by early spring were almost as high as those of untreated sheep. Treatment with phenothiazine in early spring reduced the worm-egg counts for a shorter time.

In these trials treatment with phenothiazine in autumn and before lambing increased fleece weights by about 5 oz., body weights of the gimmers and ewes by an average of about 2¼ lb. and body weights of lambs by about 2 lb. The percentage of lambs reared was not affected significantly.

The results of the trials did not clearly indicate the value of treatment of gimmers and ewes after lambing, but suggested that it might have an adverse effect on the body weights of their lambs at weaning.

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References

Anon. (1954). *Rep. sci. Res. Ass., Canberra.*, **6**, 55.
Anon. (1955). *Scot. Agric.*, **35**, 111.
Baker, N. F., Allen, P. H., Longhurst, W. M. & Douglas, J. R. (1959). *Amer. J. vet. Res.*, **20**, 409.
Crofton, H. D. (1949). *Parasitology*, **39**, 274.
Crofton, H. D. (1954). *Parasitology*, **44**, 465.
Crofton, H. D. (1958). *Parasitology*, **48**, 243.
Douglas, J. R., Baker, N. F. and Longhurst, W. M. (1956). *Amer. J. ver. Res.*, **17**, 318.
Douglas, J. R., Baker, N. F. and Longhurst, W. M. (1959). *Amer. J. ver. Res.*, **20**, 201.
Forsyth, B. A. (1959). *Aust. vet. J.*, **35**, 99.
Foster, A. O. (1955). *Vet. Med.*, **50**, 427.
Gordon, H. McL. (1940). *J. Coun. sci. industr. Res. Aust.*, **13**, 85.
Gordon, H. McL. (1953). *Pastoral Rev.* **63**, 607.
Gordon, H. McL. (1956). *Aust. vet. J.*, **32**, 258.
Haberman, R. T., Foster, A. O. and Hummon, O. J. (1942). *N. Amer. Vet.*, **23**, 390.
Harwood, P. D. (1953). *Exp. Parasit.*, **2**, 428.
Hungerford, T. G. and Howe, K. (1956). *Agric. Gaz. N.S.W.*, **55**, 92.
Kingsbury, P. A. (1958). *Vet. Rec.*, **70**, 523.
Leiper, J. W. G. and Peters, B. G. (1941). *J. Helminth.*, **19**, 71.
Morgan, D. O., Parnell, I. W. and Rayski, C. (1950) *J. Helminth.*, **24**, 101.
Morgan, D. O., Parnell, I. W. and Rayski, C. (1951). *J. Helminth.*, **25**, 177.
Morgan, D. O., Parnell, I. W. and Rayski, C. (1952). *Scot. Agric.*, **32**, 46.
Morgan, D. O. and Sloan, J. E. N. (1947). *Scot. Agric.*, **27**, 28.
Moule, G. R. and Jackson, M. N. S. (1949). *Qd agric. J.*, **69**, 235.
Parnell, I. W. (1939). *Sci. Agric.*, **20**, 205.
Parnell, I. W. (1954). *Brit. vet. J.*, **110**, 499.
Parnell, I. W. (1961). *Wool. Technol. Sheep Breed.* (in press).
Parnell, I. W. and Dunn, A. M. (1960). *Brit. vet. J.*, **116**, 9.
Parnell, I. W., Dunn, A. M., Mackintosh, G. M. and Reeve, E. C. R. (1955*a*). *Brit. vet. J.*, **111**, 195.
Parnell, I. W., Dunn, A. M. and Reeve, E. C. R. (1955*b*). *Brit. vet. J.*, **111**, 519.
Parnell, I. W., Rayski, C., Dunn, A. M. and Mackintosh, G. M. (1954). *J. Helminth.*, **28**, 53-110.
Paver, H., Parnell, I. W. and Morgan, D. O. (1955). *J. comp. Path.*, **65**, 220.
Thomas, P. L. and Elliott, D. C. (1957). *N.Z. vet. J.*, **5**, 66.
Warwick, B. L., Turk, R. D. and Berry, R. O. (1946). *J. Amer. vet. med. Ass.*, **108**, 41.
Whitten, L. K. (1956). *N. Z. vet. J.*, **4**, 63.
Whitten, L. K. (1958). *Sheepfmg Annu.*, 223.
Wilson, A. L., Morgan, D. O., Parnell, I. W. and Rayski, C. (1953). *Brit. vet. J.*, **109**, 179.

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SURVEYS OF LIVESTOCK DISEASES

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It is by no means a simple matter to give accurate or even relatively accurate estimates of losses to the livestock industry because of animal disease or of the effects of the zoonoses on the well-being and working capacity of the human population in a country or area. It is appreciated by all concerned that animal disease plays a large part in difficulties in increasing and improving livestock production in individual countries and throughout the whole world and, together with its influence on human life, is of considerable importance in a country's economy. From time to time, surveys have been carried out with a view to obtaining more sound information on the importance of disease to a country's welfare and, so far as they have gone, such surveys have been instructive. Attention has been directed to the need for such surveys and to the value which information from the data collected from them would have in several directions. We require as reliable information as possible to convince livestock owners of the losses which they themselves are incurring from sickness and deaths among their animals; to show the various authorities the need to support schemes for the control of disease and to encourage, financially and otherwise, research work to devise applicable methods of control, leading eventually to eradication of diseases; to place diseases in their order of importance in causing interference with animal production, human health and agricultural and national economy; and to ascertain how far preventive methods for the control of diseases are being practised and their results, not only in individual herds and flocks, not only in a specific district, but throughout a country.

Many articles have been published in this and other countries on attempts to gather information on the extent of different diseases in a district and in districts throughout a country. Undoubtedly the findings from such enquiries have proved of considerable value and have indicated the importance of this type of work. There is need, however, for much expansion of the survey kind of enquiry in all countries and the publication of the results.

Our knowledge of the occurrence, incidence, spread and control of animal diseases which are "notifiable" is, of course, ensured. Throughout the world, however, there is, as yet, no general agreement on which diseases should be made "notifiable." As is to be expected, diseases which have proved to be highly infective and which, in particular, have at one time invaded the country and have tended to spread and to cause spectacular loss, often by deaths of infected animals or by disruption of the livestock industry, have been selected to be classed as "notifiable". Notification of certain diseases is

compulsory in practically all parts of the world; in other parts, there is considerable variation in the actual diseases in the notifiable list.

Veterinarians and especially those engaged in practice are in a position to form fairly accurate opinions on the importance of the various diseases which interfere with the health and, therefore, the production of livestock. Their day-to-day activities bring them into intimate association with livestock and the livestock industry and, although they may not be in such close contact with the health of livestock as are the medical profession with human health, the views of veterinarians in practice on the whole subject of animal health in their districts must be quite extensive.

In surveys, however, we go further than depend upon general views, even if they are supported by experience. We wish to have detailed information on practically every animal. If the application of such a condition were to be applied to a whole country, an impossible task would be set and but little progress could be expected. By adopting the method of random sampling, by selecting herds and flocks and farms typical of those throughout the different districts of a country, with different types of management, different breeds and different sizes, and by the application of modern methods of statistical analysis, it is possible to obtain a fairly definite picture, representative of the whole country. The planning of such surveys is all-important. Veterinarians and livestock owners must be consulted but the actual selection of the farms, herds and flocks to be surveyed and the method to be used must always be made in the closest collaboration with statistical workers experienced in this or allied subjects. It is the work of such statisticians which, ultimately, will enable the data collected from the surveys to give information on the most probable position throughout the country.

It is also impossible, even in a survey of animal health and disease of limited extent, to have full veterinary guidance on every animal. A considerable amount of reliance has, therefore, to be placed on the livestock owners and their staffs. In this connection, advantage has to be taken of the experience and reliability of livestock owners or their staffs concerning some of the commoner and, probably, less serious illnesses which occur and with which they have become familiar. Although veterinary attention is sought by the many livestock owners for the major diseases, many minor conditions arise among livestock, conditions which play important parts in livestock production, which are dealt with in the absence of veterinary attendance. All these have to be taken into account in these surveys, in order to obtain the true picture of losses from disease.

We are very happy to note that two surveys have been recently carried out on lines which conform to those which we believe will present as accurate a picture as possible on this important subject. The results have been published in the form of individual reports: one "Survey of Livestock Diseases in Northern Ireland", the other, "Disease Wastage and Husbandry in the British Dairy Herd", both published by H.M. Stationery Office, from whose branches throughout Great Britain and Northern Ireland copies may be purchased.

As these reports differ materially, we will refer separately to them.

*Survey of Livestock Diseases in Northern Ireland.**

This is an extensive report of a survey carried out in 1954-55 on 623 farms in Northern Ireland, so selected as to be a random sample from which representative data would be obtained for later statistical analysis. The survey, carried out by veterinary officers of the Ministry of Agriculture, who visited the farms every three months during the two years, was part of a programme undertaken with financial assistance from the Conditional Aid Fund of the United States of America. Veterinarians in practice and the Veterinary Laboratory, Stormont, collaborated in the work. The plan of the survey was drawn up in consultation with members of the Department of Statistics, Rothamsted Experimental Station, Herts, England and all required data entered on record forms by the livestock owners and their staffs were transferred to Hollerith cards for subsequent statistical analysis. In all, some 20,000 record forms were used and 3,333 visits to the farms in the survey were made by the veterinary officers.

The survey concerned cattle, sheep and pigs and, hence, the selected farms had such livestock: 23·6 per cent had cattle alone, 27·0 per cent had cattle, sheep and pigs, 41·3 per cent had cattle and pigs, 7·9 per cent had cattle and sheep and 0·2 per cent had pigs alone; none of the farms had only sheep.

The report is extremely well supplied with descriptive tables, 192 in all, and their perusal is often almost enough to provide a clear expression of the collected data. There are also several maps and figures by way of illustration, a glossary of terms, especially concerning diseases, is provided and a bibliography of 116 published articles and reports is included and is widely referred to throughout the text.

While the incidence of the various diseases influencing wastage is fully reported and considered, the report contains much other information on farms, cattle, sheep and pigs in Northern Ireland. Examples are size of herds, breeds of livestock and their distribution, birth rates, seasonality of births and occurrences of losses and abattoir statistics of numbers of animals slaughtered and of numbers of carcases completely and partially condemned. An interesting small section deals with the Tuberculosis (Attested Herds) Scheme in which it is shown that of the 879,400 cattles in Northern Ireland at the end of 1955, 81,525 were in 2,864 attested herds and 41,346 in 1,941 supervised herds: this means that at that time about 14 per cent of the cattle in Northern Ireland were in attested or supervised herds. (Doubtless the position today is very different.)

Separate sections of the report, each of several chapters, deal with cattle, sheep and pigs, in turn, and at the end of each section there is a chapter on "Discussion" of the survey of disease in that particular animal. A final chapter considers "notifiable" animal disease.

This whole report makes most interesting and instructive reading and an important feature is the reference to the many published articles and reports

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* Survey of Livestock Diseases in Northern Ireland by J. F. Gracey, Ph.D., M.R.C.V.S., D.V.S.M., 182 pages, numerous tables, figures and maps. H.M. Stationery Office. Price 12s. 6d. net.

in different countries with which comparisons of the data from the survey are compared.

There are many items in the report to which we would like to refer to show its extent and the details of disease and losses from disease which have been provided by this survey. A few examples only, however, can be given and it is hoped that they will stimulate not only veterinarians, but also the many others who must be interested in livestock production, to study this report in detail.

From the data in the survey, it is estimated that the average productive life of a dairy cow in Northern Ireland is five lactations, i.e. a life of eight years.

In the farms in the survey, 3·4 per cent of the calves were born dead and, of those born alive, 2·8 per cent had died before the age of six months. From these findings, it is stated that one in every 15 pregnancies in cattle failed to produce a calf which was alive at six months of age. Brucellosis accounted for 27 per cent of the calves born dead. The majority of postnatal deaths occurred within two days of birth, the causes being *Bacterium coli* septicaemia (59·1 per cent) and white scour (40·9 per cent); other causes were a weakly condition at birth, non-infectious conditions of the digestive tract, some respiratory disease and joint ill. It is interesting that, in this age group, parasitic infestations are given as the cause of only 2·7 per cent of the deaths.

Among the cows in the survey, 1·2 per cent died; it is estimated that in Northern Ireland about 3,150 die each year. While a variety of causes are given, the survey showed that 18·9 per cent of the deaths of the cows arose from metabolic disturbance (milk fever, grass tetany, acetonaemia, hypocalcaemia and hypomagnesaemia), while a further 16 per cent were from diseases of the urogenital system (metritis, etc.). Specific infectious diseases (tuberculosis, piroplasmosis, Johne's disease and black-quarter) accounted for a further 10 per cent. There were also some rare instances of pneumonia, nervous diseases and poisoning (ragwort and Paris Green).

All these figures refer to actual deaths; disposals of cows are also quoted. In the two years of the survey 17·9 per cent were disposed of, and of this number the cause was disease in 52·2 per cent, the main diseases being infertility, mastitis, abortions and reactions to tuberculin.

In young cattle (over six months old) the picture is different. Here the important causes of deaths, which amounted to 1·7 per cent of the animals of this age in the survey, were parasitic diseases (33·5 per cent), specific infectious diseases (black-quarter, piroplasmosis, tuberculosis and salmonellosis, in that order) 23·2 per cent, accidents (13·4 per cent), diseases of the digestive system (11·6 per cent) and diseases of the respiratory system (5·4 per cent). Hoose was the most prevalent of the parasitic diseases.

A very interesting table shows the attendance to sick cattle by practising veterinarians in the survey district.

Statistics of the North of Ireland abattoirs are freely quoted. The most prevalent cause of total or partial condemnations of carcases of slaughtered cattle was tuberculosis. It is also recorded that the prevalence of liver-fluke infestation led to a total loss of about 380 tons of bovine and sheep liver—

about 61 per cent of all the available liver, which in turn meant an average monetary loss of 17 shillings per cow and one shilling and three pence per sheep. In 1955, bovine cysticercosis was found in 0·5 per cent of slaughtered cattle and mostly in young animals. It is also stated that in 1954, some 50 per cent of the hides offered for sale in Belfast showed evidence of warble-fly larvae activity and that tick bites reduced the value of hides, especially those of light-weight cattle, by tenpence per hide.

During the 1954 part of the survey, the lambs born from each 100 ewes averaged 124, of which 119 were born alive, and in 1955 the average was 123 with 118 live births. In 1955, 1·4 per cent of all ewe pregnancies terminated in abortion.

The postnatal death rate in lambs in the survey was 11·2 per cent. It is estimated that, in Northern Ireland, 57,190 lambs die annually, about half in the first 48 hours and another 5 per cent in the first week of life.

The main cause of these early deaths is adverse weather conditions, leading to lack of milk in the ewes and starvation and exposure of the lambs. About 15·7 per cent of the deaths of older lambs arose from pulpy kidney disease and 2·5 per cent from tick pyaemia.

The death rate of ewes in the two years was an average of 5·8 per cent, mostly in animals over five years old and during the first four months of each year. The main causes are given as pregnancy toxaemia (20 per cent), accidents and injuries (17·4 per cent), including worrying by dogs (5·6 per cent), and specific infectious diseases (enterotoxaemia, braxy, black disease, etc.) (14·2 per cent).

Among yearling sheep there was a death rate of 4·8 per cent and among rams it was 8·6 per cent, the main cause being ascribed to braxy (20·9 per cent).

It is estimated that, throughout Northern Ireland, some 87,000 sheep die each year.

There is, of course, sickness in sheep which do not die. The mean incidence in the lambs in the survey was found to be 16·6 per cent with a death rate of 11·2 per cent, i.e. 88 per cent of the sick lambs died. Some 9·3 per cent of the ewes were reported as sick and 5·7 per cent of them died.

While there were reliable preventive measures for the control of some of the major diseases of sheep, it is somewhat surprising to read of the considerable losses attributed to them in the survey. A short chapter contains some information on the extent to which prophylactic treatment was carried out. Systematic use of anthelmintics was adopted on 6·1 per cent of the farms, higher percentages of the farms dosed the sheep in the autumn, the spring and the autumn, or when thought necessary, while 17·9 per cent did not use anthelmintic treatment. Pulpy kidney prophylactic vaccination was applied on 43·1 per cent of the survey farms, while vaccination against braxy and enterotoxaemia in older sheep was practised on 9·2 per cent of the farms.

While clinical liver fluke disease was reported in only 0·7 per cent of the sheep, the abattoir statistics show that 22·9 per cent of the slaughtered sheep were affected in some degree.

The average litter of sows in Northern Ireland is about 11 piglets: there is an average farrowing of 1·7 per year per sow, with 19·3 piglets. The average number of piglets reared per litter is 9·1.

In the survey, 5·2 per cent of piglets were stillborn and of those born 9live, 19·1 per cent died in early life, mostly from the results of being crushed, weakly condition at birth, and scours and anaemia which accounted for 5·4 per cent of the deaths.

Post-weaning losses amounted to 2·6 per cent in 1954 and 3·3 per cent in 1955, i.e. an average for the two-year period of 2·9 per cent. Of these losses, 85 per cent took place during the first four months of life, 13·6 per cent of this loss being attributed to bowel oedema and 13 per cent to gastroenteritis.

During the two years, some 19 per cent of the total number of pigs showed some type of sickness; of this percentage there were 30 per cent of piglets, 10·7 per cent of weaned pigs and 15·5 per cent of sows. The important causes in the sows were infertility, mastitis, abortion, agalactia and metritis.

The scouring-anaemia complex syndrome in piglets ranked next to overlaying, stillbirths and weakly conditions as the cause of death. It is stated, however, that true piglet anaemia is not so prevalent as is generally considered: some 77 per cent of the farms in the survey adopted preventive measures. The prevalent scouring in the piglets was probably associated more with digestive troubles, deprivation of colostrum, viruses and unsatisfactory environmental conditions.

In 1955, a total of 22,238 lb. of fat pig carcase meat was condemned in the form of total carcases and 4,837 lb. as parts of carcases. Tuberculosis, generalized and localized, accounted for much of the condemnations; other noteworthy causes were generalized decomposition, pyaemia, abscesses and bruising. Among carcases of pigs slaughtered as a matter of emergency, condemnations, total or partial, accounted for 11,629 lb.; ten causes were given, of which fever and decomposition were the most outstanding.

The final chapter deals with notifiable diseases: during 1954-55, 336 cattle were seized and slaughtered under the 1938 Bovine Tuberculosis Order. It is stated that the number of cattle seized under this order has steadily declined from a peak of 927 in 1935 to 148 in 1955 and that this position reflects progress under the Tuberculosis (Attested Herds) Scheme. During the period of the survey there were 39 outbreaks of sheep scab and 16 of anthrax. A table shows the number of outbreaks of the various scheduled diseases in Northern Ireland in 1935-1955. Johne's disease (paratuberculosis) is also dealt with . It is only since 1951 that a voluntary notification scheme for Johne's disease has been operated in Northern Ireland and compensation paid for confirmed cases. Further, all cattle coming into Northern Ireland must pass the complement fixation test within the 28 days before their introduction. It is shown that in the 1951-55 period, 90 cases of the disease were confirmed, which represents a low incidence in comparison with some other parts of the world. In the survey herds the only cases were one in cattle and one in an aged ewe.

It is now over five years since the survey was completed. The data in the report indicates the position in 1954-55. Undoubtedly, changes have occurred

in the intervening period. It would be of considerable interest and value if a further survey could be carried out in the near future; from it information might be obtained on steps which have been taken to prevent at least some of the livestock losses and the results.

Disease, Wastage and Husbandry in the British Dairy Herd, 1957-58*.

The survey with which this report deals differs from that carried out in Northern Ireland in that only dairy herds were studied. Some earlier surveys had been carried out in different parts of Great Britain mainly by the staff of the Central Veterinary Laboratory, Weybridge, and from the experience gained in these surveys, especially of planning and analysing the data collected, this present survey was arranged and was carried out by the Animal Health Division of the Ministry of Agriculture, Fisheries and Food, the statistical work being done at the Department of Statistics, Rothamsted Experimental Station.

The period covered was from 1st October, 1957 to 30th September, 1958. At the beginning, a random sample of 1,508 herds was selected and finally data from 1,158 herds, with some 31,000 cows, was analysed. In this sample, different areas in Great Britain, herds of different sizes and containing different breeds of cattle and under different types of management, were included as representing the British dairy herd. The farmers made and kept records of morbidity and veterinary officers visited each of the herds in the survey at least three times during the year. The recorded information was eventually transferred to Hollerith cards, a separate card for each animal affected by a disease, or culled from the herd. In all, 19,023 such cards were prepared and from them, using modern statistical procedures, the information contained in the report was produced. A description of the methods used is given and in making estimations concerning the whole dairy cattle in the country it is stated that "the sampling error calculated for the estimate of the total number of dairy cows in the population was $\pm$ 2 per cent of the total. A more extensive study of such errors is desirable, but not essential to the analysis of this survey, for there are other sources of error in the data which are likely considerably to exceed the errors associated with sampling".

While all sick animals, and in some herds there were relatively few of them, received veterinary attention, practising veterinary surgeons in the various districts gave much valuable information and assistance during the survey. It was considered that the records kept by the farmers and their staffs would be sufficiently accurate for the purposes of the survey.

Reference is made to the Report of the Gowland Hopkins Committee in 1934 (the Cattle Diseases Committee of the Economic Advisory Council appointed in 1932), which based its assessments of the incidence and economic importance of cattle diseases mainly on statistics collected in three areas from herd record books of Milk Recording Societies. Many changes have taken

* Disease, Wastage and Husbandry in the British Dairy Herd, 1957-58, by F. B. Leach, Muriel E. Davis, W. D. Macrae and F. W. Withers: 62 pages, numerous tables, diagrams and maps. H.M. Stationery Office, Price 4s. (by post 4s. 7d.).

place since 1934 in different aspects of dairy farming; the report of this present survey is, therefore, timely.

This publication contains a vast amount of information from which valuable deductions may be made. It contains 70 tables and several figures, many of which are, indeed, self-explanatory and are excellent short illustrations of much assistance to readers. The list of references to published articles and reports which are considered in the report completes the publication.

A perusal of this publication will amply reward readers and will be found of marked interest. It is possible now to give only some examples which, it is hoped, will illustrate the results of the survey and the deductions which may be drawn from them.

The information collected does not entirely refer to the incidence of diseases: there are many references to the structure and husbandry of dairy herds and to factors which have a close bearing on the occurrence and evolution of different diseases.

The national dairy herd is reported as consisting of 2,814,000 ± 56,000 cows in 132,000 herds with an average of 21·3 cows per herd. It is estimated that 12 per cent of the served heifers and 20 per cent of the cows failed to produce a calf within the normally expected time. Friesians (39·5 per cent), Ayrshires (24·9 per cent) and Shorthorns (13·9 per cent) made up 78·3 per cent of the national herd and it was estimated that a total of 16·3 per cent of the national herd was removed from dairying during the period by death, for slaughter or for fattening. Replacements were made in accordance with the custom of the farm, either by animals bred on the farm, or imported animals, or partly by animals from each source.

A considerable amount of information concerns the pattern of British dairy farming. Examples concern the seasonal calvings in different parts of the country; the size of herds—many herds in England and Wales contain less than ten cows, while in Scotland the herds are in general much larger; natural breeding and artificial insemination—there is a greater tendency to use the latter technique in the smaller herds; the size of dairy farms—while there is much variation, the average size is 116 acres with 5·4 acres per cow; milking methods—machine milking is practised in all herds in the survey with at least 30 cows; use of Strain 19 *Br. abortus* vaccine—the estimated total number of herds in the country using the vaccine was 42 per cent in which there were 57 per cent of the total cows, and 84 per cent carried out calfhood vaccination.

A most important section deals with morbidity and contains lists and tables indicating the causes.

Abortions and stillbirths are fully dealt with as they occurred in the areas of the survey; the records showed 690 abortions (premature calvings, dead or live calves, up to and including the 270th day after the last service) and 583 stillbirths (calves born dead after the 270th day of the last service). It was considered that the ages at which the breeding animals aborted—greater during the second gestation—or at which stillbirths occurred—greater during the first gestation—were influenced by husbandry practices, including the keeping of first-calving heifers away from the cows until they have calved and

some nutritional factors in late gestation of heifers. Apparently *Brucella* infection was considered to be the main course of abortion and the seasonal variation in its occurrence is thought to be associated with infected adult cows which calve at full term. This latter observation is given as a possible new consideration. Although the incidence of abortions is related, among other things, to the use of Strain 19 vaccine, it is pointed out that this apparent relationship may be misleading because the vaccine neither eliminates the infection, nor does it entirely prevent *Brucella* infection.

Retention of the foetal membranes following abortion (30 per cent of animals which abort and 4·0 per cent of the cow population) was a serious sequel to abortion; the condition occurred also in 18 per cent of stillbirths. Subsequent infertility was also of importance. In the survey, 33 per cent of aborted animals and 18 per cent following stillbirths were culled. Dystocia is dealt with and the incidence was found to be greatest at first calvings, there being a seasonal relationship with the incidence of stillbirths.

Much of the information concerning mastitis is already known, but some interesting figures are given. Acute mastitis is more closely associated with calving than are the mild forms of the disease and "summer" mastitis: 33 per cent of the cases of the acute disease, 20 per cent of the mild form and 19 per cent of "summer" mastitis occurred within a week of calving. There was very little difference in the incidence of the disease in the various breeds. It was found that 39 per cent of cases of "summer" mastitis and 17 per cent of those with the acute disease recovered, but lost one quarter of the udder. It is estimated that some 46,300 cows (1·6 per cent) and 3,200 (0·1 per cent) of the cow milking population in the survey were milking on three and two quarters, respectively. It is suggested, because of the higher incidence of stillbirths in animals suffering from "summer" mastitis, that the disease occurring late in gestation may cause death of the foetus.

In the 1,158 farms in the survey, clinical Johne's disease was present in 19, the maximum number of affected animals in a herd being five. It was found that the clinical disease was related to age—0·3 per cent occurred during the first two lactations; 0·4 per cent in the third to fifth lactations; and 0·5 per cent in later lactations.

Foul-in-the-foot, most prevalent in Friesians, affected an average of 2·8 per cent of the animals and, occasionally, up to 20 or 30 per cent. Its occurrence led to the culling of 15 per cent of the 873 affected animals. In 2 per cent, septicaemia, pneumonia or arthritis developed—i.e. in 0·06 per cent of the population; chronic lameness in some animals prevented further breeding.

Milk fever, acetonaemia and grass tetany are considered together and it was found that the incidence of each changed markedly in successive lactations: milk fever and grass tetany became increasingly more common in each lactation, while acetonaemia increased up to the fourth lactation and then slightly decreased. There was no marked difference in the regional distribution of acetonaemia and grass tetany, the tendency being for their occurrence to decrease from north to south and from east to west. Acetonaemia and grass tetany were more prevalent in Ayrshires—52 and 68 per cent respectively.

There were higher incidences of acetonaemia, grass tetany and dystocia in cows affected with milk fever than in the general cow population.

Bloat was recorded in October-December and in April-May, mostly in the former period. Of the affected animals in the survey, 35 per cent were culled of which 22 per cent had died or had failed to recover.

Redwater (babesiosis) was reported only in 37 of the animals in the survey. All were in Wales, Devon and Cornwall except one in Dorset and one in Staffordshire. It is estimated that the incidence of redwater in the national herd is: Wales—0·35 per cent, Devon—0·66 per cent, Cornwall—0·85 per cent of the total cows.

Infertility was judged on cows which returned to oestrus after a third service or in which there was absence or irregularity of the oestrous cycle. Information, including several tables, is given on the culling of cows because of infertility and on various factors associated with the condition. It was estimated that infertility was the reason for culling 3·7 per cent of the cows in the survey, of which 3·4 were sold for slaughter or fattening while 0·3 per cent went for further dairy purposes.

A most important and instructive section deals with culling, the reasons for which are grouped into seven categories: animals which died on the farm, old age, infertility, low yield, sickness and accident, reaction to tuberculin and surplus animals. From the results of the survey it is estimated that the percentage total of culled cows in the national herd was 24·2. Some tables give valuable information on reasons for culling, the monies received for culled animals, the regional variation in culling and the effects of disease and low milk yield on the productive life of cows. It is estimated that of the total rate of culling in the national herd (24·2 per cent), 7·8 per cent remained in the dairy industry, 13·6 per cent were slaughtered or died and 2·8 per cent went out of the industry for fattening.

A table compares the data in the Economic Advisory Council Report (1934) with that now presented, in which the respective percentages of disposals of animals are given as 21·9 and 24·2. A further table shows the national estimates of total depreciation in market value caused by mastitis, Johne's disease, injuries and accidents, and trouble at calving, amounting, in all, to £2,002,000. These four diseases are considered to be the principal causes of depreciation in market value. It is pointed out, however, that the financial data of losses submitted was based on the prices received for cows removed from herds and that other sources of loss are associated with the reduction in the productive life of the cow, the loss of a calf or aborted feotus, the loss of milk during the course of the disease and the cost of attending and treating the diseased animal. These are but examples of the information from this survey.

This publication provides in no small measure, information of much value to those concerned with the control of animal health and the economic aspects of dairying and milk production. The country required such information and it is to be hoped that full advantage will be taken of it by all those concerned. There is room for further similar types of surveys not only in connection with

dairy herds, but with regard to other species of animals, e.g. sheep and pigs. From the foreword to this publication we are informed that this survey has been repeated in 1958-59 on a different sample of herds: we look forward to an account of the findings.

Such surveys mean a vast amount of work and organization: the value of their results, however, cannot be over-estimated and we hope that, now that a beginning has been made and experience gained, we will find further opportunities in the future to write on published reports concerning them, giving examples of the position of disease and other causes of loss to the livestock industry. We can thoroughly recommend veterinarians and others interested in livestock health and production to devote some time to this interesting publication.

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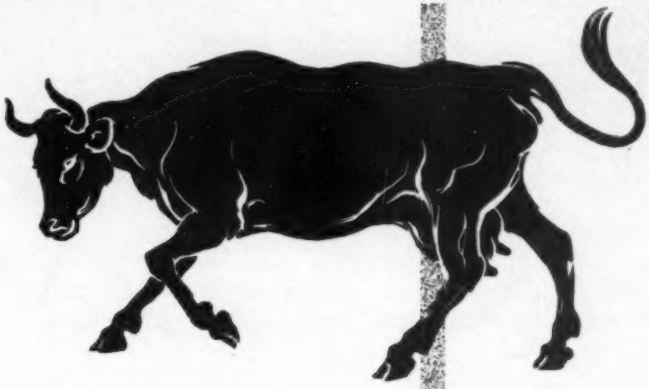

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GREYHOUND RACING–DUTIES OF THE VETERINARY SURGEON AT TRACKS

By J. K. Bateman

Greyhound Racing Association Ltd., Potters Bar, Middlesex

All greyhound tracks licensed by the National Greyhound Racing Club must employ a qualified veterinary surgeon who is licensed by the Club and whose conduct is governed by their rules. These include attendance by the veterinary surgeon at the track from the time greyhounds are kennelled until the meeting is over. He is responsible to the Stewards of the meeting, and in addition to the duties detailed hereafter he is expected to obey any reasonable requests of the Stewards. These may include the taking of tests of

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It is a rule that all competing greyhounds must be locked up in racing kennels at the tracks at least one hour before the first race. After each greyhound has been identified and weighed, it is inspected by the appointed veterinary surgeon. He has some latitude in the inspection, but his personal reputation is at stake and he is well advised to give the matter his undivided attention. The points he should note especially are:

(1) That he is dealing with reputable licensed trainers who usually have a sound knowledge of their charges, wish to win races and present a fit dog in good health;

(2) that he should learn to notice the greyhound whose abdomen is tense and that which is normally somewhat flabby, but not distended;

(3) that a bitch in season is not allowed to race, but that since it is a common belief that a bitch is at her peak when just about to show pro-oestrous bleeding, an effort may be made to get such a bitch passed unnoticed by the veterinary surgeon;

(4) that some greyhounds have a gait which varies from the normal, maybe only slightly, but which nevertheless is noticeable;

(5) that he should look for evidence of administration of drugs—for example, excitability, depression, or unsteadiness of gait.

The approach by the veterinary surgeon to these points is as follows:

Inspection re fitness. He is not expected to take temperatures, feel pulses, etc., unless the greyhound looks abnormal. Neither need he examine the greyhound physically unless his doubts or suspicions are aroused. Temperatures and pulse rate in an excited animal are unreliable. The best guide will be in the colour of the visible mucous membranes and the character of the pulse. No greyhound with a wound or sore should be passed as fit, nor should one which has any sticking plaster fixed on it. Skin disease does not necessarily disqualify, although gross cases should not be passed. No greyhound which has recently

been dressed externally with any substance may race, and it is not permissible to give any type of drug within 48 hours of the day of racing. The veterinary surgeon, then, will quickly look over each dog, form an opinion on his fitness, test, say, a doubtful toe and ask the attendant to trot the dog away and watch it turn and come back.

Abdomen shape. Greyhounds with full bladders, or after a recent feed or drink, show evidence of it in the shape of the abdomen. When in doubt, present weight should be checked against previous weights and the trainer questioned with regard to the dog's normal appearance; the greyhound should be passed on the trainer's opinion of normality.

Bitches in season. No greyhound bitch which is in season may race. The rule is clear and the veterinary surgeon must not be a party to breaking the rules, although owners and trainers are often bitterly disappointed.

Gait. Abnormal gait need not be lameness. The veterinary surgeon should discuss the matter with the trainer and ask the latter to view the dog at the trot in his presence. The trainer will say whether he thinks that is the normal gait and thereafter he accepts responsibility. It can be quite humiliating for the veterinary surgeon to be dogmatic and refuse a dog permission to race which, with unaltered gait, will run a fast trial 24 hours later and continue to race at each meeting with its abnormal movement.

Administration of drugs. The detection of this requires considerable adroitness. Most of it is done to slow down a dog's pace. To slow is to depress and to depress is to lose some co-ordination. Affected dogs are unable to turn in their own length, they drag their toe nails on the ground, are apt to take quick recovering steps after an initial stumble, and invariably are unable to lift their feet, without making mistakes, over a low barrier. Steps should be taken by the veterinary surgeon to satisfy himself that the dog examined is capable of carrying out these movements. He must eliminate tonsillitis and concurrent fibrositis as a cause, and he cannot rely on pupillary reflex. The final word is his, and he need feel no embarrassment in refusing to allow a suspect dog to race—even if subsequent analysis fails to detect the presence of a drug.

After all greyhounds have been thus inspected and kennelled, the kennels are locked and no unauthorized person is allowed to go in. Although the veterinary surgeon is so authorized, he will not seek re-entry unless there is obviously a dog in trouble.

At a stated time before the first race the engaged greyhounds are released and handed over to kennel staff to be taken to the paddock. As the greyhounds leave the kennels, they should be viewed by the veterinary surgeon who will satisfy himself that each dog is still fit to race (a dog may cut his foot or injure himself in some way during the locked-up period). Greyhounds are then fitted with muzzles and racing jackets and in about 10 minutes leave the paddock to walk round the track. Often the veterinary surgeon will be asked to ensure that muzzles are not too tight and that racing jackets are properly fitted. He should regard himself as the final authority on this matter.

Although not required to watch each race, most veterinary surgeons do so and thus learn a great deal about the hazards which the greyhounds encounter

and the types of injuries which arise. Being readily available, he is in a position to render immediate first aid and even more important, perhaps, he is often able to prevent further, serious, injury to a greyhound already injured.

After each race he must see each participant return to the paddock, report any lame dog to the Stewards of the meeting, and be available to take samples on the Stewards' instruction, if so required. The taking of samples is required occasionally because of an indifferent display by any particular dog. The *modus operandi* is this:

If a greyhound has run much below form, the Stewards will ring the paddock immediately after the race and ask the veterinary surgeon to examine the animal. If the veterinary surgeon cannot find any physical reason for the poor display he reports this to the Stewards, who may ask for samples. The dog in question is given a half a cup of milk, then removed to the surgery and given a piece of washing soda, after which it promptly vomits. The remainder of the soda is removed from the receptacle, and contents are put in a clean jar which is closed, sealed, labelled and handed over to the stadium security officer. After this, a sample of urine is collected in a receptacle, without the aid of a catheter, and this too is sealed and handed over.

After the last greyhound has raced, and any injuries have been treated, the veterinary surgeon's duties are over. What happens about the samples is not his province, but it cannot be too strongly emphasized that a greyhound's poor performance is not often due to interference. Many an animal is made to vomit after a race to obtain a specimen for analysis because the veterinary surgeon has failed to detect, that evening, a muscle or other injury which will be all too obvious on the following day. Again, he may offer an opinion which is not acceptable to the Stewards and the sample-taking process goes ahead. Nevertheless his duties are to abide by the rules and he will wisely ignore what he may well take to be criticism of his professional competence. The analyst's report may prove that the Stewards are justified, hence the advisability of saying nothing and obeying the rules. On the other hand the analyst may send a negative report and the subsequent behaviour of the greyhound may justify the previously expressed opinion. This enhances the status of the veterinary surgeon in the eyes of all concerned, and his opinion will be given greater credence in the future.

Serious Accidents—The Position of the Veterinary Surgeon

The National Greyhound Racing Club rules state that "if in the opinion of the Veterinary Surgeon the destruction of a greyhound or an urgent operation is necessary, he shall be entitled to proceed with either of these operations without the permission of the Owner if the latter is not present and objects". Also, "a greyhound kennelled at the training kennels should not be destroyed except with the approval and under the direct supervision of a qualified Veterinary Surgeon, etc."

The veterinary surgeon will soon become aware that a dead greyhound tends to increase in value in the opinion of the owner, immediately it is

destroyed. The potential value, i.e. the amount the owner may think the dog might have earned had it lived, tends to be magnified.

In order to obviate claims and unpleasantness, it is usually advisable, in the ordinary track accident, to administer a long-acting anaesthetic, make the dog comfortable and free from pain, transfer it to hospital kennels and re-examine the following day.

Apart from the possible chance of the efforts of the veterinary surgeon, or those of a more experienced colleague, being able to effect complete recovery, it has to be borne in mind that greyhounds may perform their functions at stud with only three legs, for instance. His or her blood lines might be extremely valuable. The veterinary surgeon, therefore, would do well not to shelter behind the National Greyhound Racing Club rule, except in a few very serious accidents, but to save the dog's life for the present until more consideration can be given to the case.

It can be seen then that the veterinary surgeon appointed to a greyhound race meeting has a serious job to do. His professional status keeps him apart from all betting. If he applies his mind to the health, soundness and performance of the greyhounds, he will learn much that can be of benefit to him in his ordinary practice.

(*Received for publication*, 22 *March* 1961)

BOOK REVIEWS

The Artificial Insemination of Farm Animals. Third revised edition. Edited by Enos J. Perry. 430 pp. New Jersey: Rutgers University Press $6.50; and London: Mark Paterson Ltd.

This edition of a now famous book is a considerable improvement on its predecessors largely because of the inclusion of some new chapters and the modernization of others. One of the welcome additions is the section on evaluation of semen by chemical analysis, which condenses into eleven pages the present state of knowledge of the chemistry of semen. It is written in concise and clear terms which makes the subject easy and pleasant to read. A valuable section on artificial insemination of buffaloes is another addition to this volume and is authoritatively and well written by Bhattacharya. The subject is dealt with widely and the information given will be of value to developing countries where buffalo breeding is of considerable agricultural importance. No volume on artificial insemination is complete without reference to low-temperature storage of semen and this is dealt with in detail in another new section which gives all aspects of the techniques employed in the various freezing media. Information is brought up to date in an improved section dealing with artificial insemination of many classes of stock, including sheep and goats, dogs, poultry, horses and pigs. Bringing the technical processes into perspective are three sections dealing effectively with genetical aspects of livestock breeding and of selection for improvement.

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While there is much in the new volume to be praised, some parts could be improved. It would be useful, for instance, to reduce somewhat the detailed descriptions of the various artificial breeding organizations in the United States and to include some reference to those in existence in other areas, particularly Western Europe. While in a work of this nature some overlapping is unavoidable it is in some cases unnecessary. One is surprised, for instance, to read about pregnancy rates and embryonic death in the section describing the male and female organs of reproduction. In the same section male service behaviour is dealt with, a subject which is perhaps more appropriately discussed in the section on factors influencing the quality and quantity of semen. Standards of technical description vary greatly throughout the volume; for example, a highly technical description of chemistry of semen must be compared with references in a later chapter to such things as explaining that the fine adjustment of the microscope means the "small wheel"!

Minor criticisms apart, this is a very useful addition to a library and contains a mass of technical information of value to all interested in artificial breeding. References are abundant and the volume is well presented in good quality paper.

A. F. HOLT

The Rickettsial Diseases. P. F. ZDRODOVSKII and E. H. GOLINEVICH. English edition, pp. 629, with 159 illustrations. Oxford: Pergamon Press. £5 5s.

This book is a translation of the second Russian edition published in 1956. For the English edition, the text was revised and new literature, up to and including 1958, added. The book is arranged in two sections, the first dealing with the general characteristics of the rickettsiae in terms of vectors, growth, variation, survival and the serodiagnostic methods available for rickettsial diseases. The second section of the book deals with specific rickettsial diseases and in addition contains chapters on the chemotherapy, pathology, immunological relationships, and vaccine prophylaxis of rickettsial diseases.

The authors have prepared a most detailed and extensive tome on a relatively small, albeit important, group of organisms. In addition to a very comprehensive historical coverage of rickettsial studies, not only in Russia but throughout the world, the authors have made reference to more recent advances in our knowledge of rickettsia. Included in this latter category are such items as the growth of certain rickettsiae in tissue culture, the antigenic variations encountered in Q fever rickettsiae as reported by Stoker and Fiset, and the transformation experiments of Price *et al.* on the conversion of *R. prowazeki* into *R. mooseri*. The majority of the newer advances, however, are given only a very cursory statement and so are of limited value except in so far as they call attention to the various new areas of research.

Though the Russian authors freely quote work carried out in Russia, they also discuss, in many cases with considerable detail, results obtained by investigators throughout the world, thus giving the book a greater value to rickettsial workers everywhere.

The book is well written and quite readable. It contains numerous photographs, charts and tables which are of considerable value in reading the text itself. The book is well documented, although the number of references included for 1957 and 1958 is small in number. The references are arranged in a most unusual fashion; they are all at the end of the book and the Russian references are listed separately from those of the rest of the world. In addition, the references for the second section of the book are separated into specific diseases and again subdivided into Russian and those from the remainder of the world. The index seems to be somewhat inadequate because there is little cross-indexing, and to find a reference to a specific item, for example the Erythrocyte-Sensitizing Substance (ESS) test devised by Chang, is quite difficult. However, by looking under various major topics the subject can finally be located.

This is an extensive treatise on a very important group of organisms. It fills an important place alongside the earlier books on rickettsial diseases published many years ago. It should prove of value to all scientists, regardless of their special training, who are interested in the problems associated with the growth of rickettsiae and the diagnosis and prevention of rickettsial diseases.

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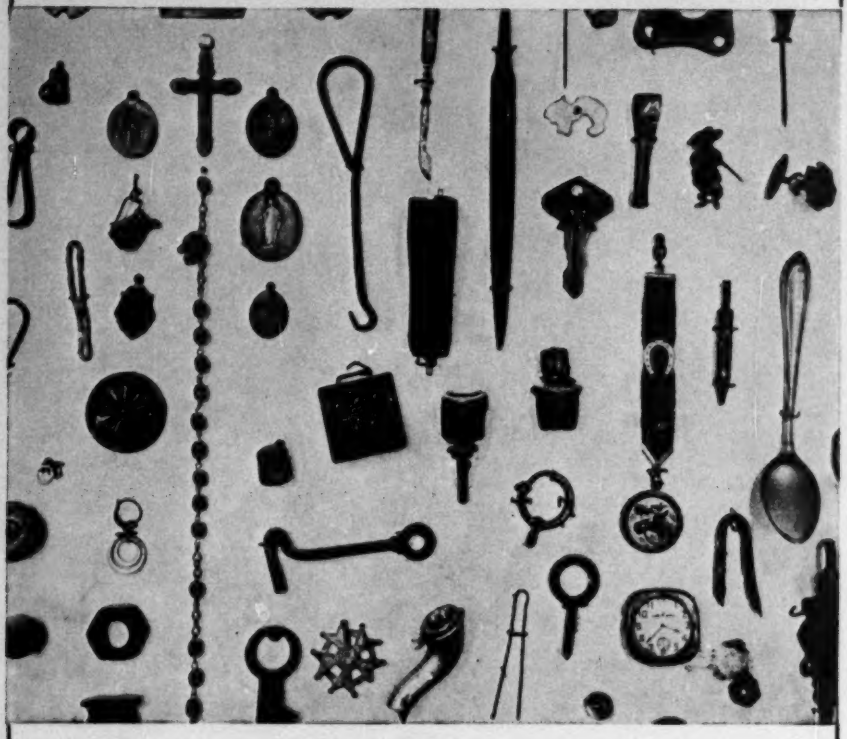

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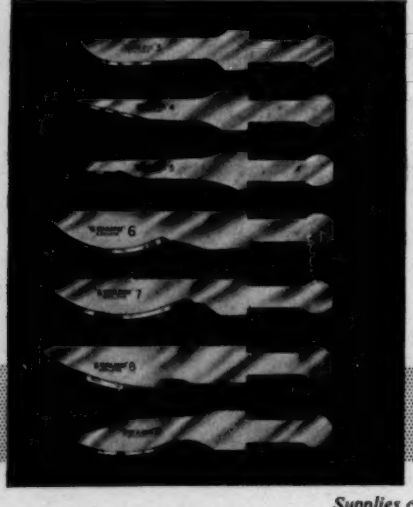

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The July issue (Vol. 117, Number 7) will contain the following papers:

J. Reid, *Animal Health Division, Ministry of Agriculture, Fisheries and Food.*	The Control of Newcastle Disease in Great Britain.
J. Hoekstra, *Rotterdam.*	Control of Newcastle Disease and Infectious Bronchitis by Vaccination.
A. Brion, *National Veterinary College, Alfort, France.*	Aetiology and Control of Chronic Respiratory Disease.
R. A. Bankowski, *University of California, Davis, California.*	Respiratory Disease Complex of Chickens in the United States.
J. G. Campbell, *British Empire Cancer Campaign Unit, Poultry Research Centre, Edinburgh.*	A Proposed Classification of the Leucosis Complex and Fowl Paralysis.
P. M. Biggs, *Houghton Poultry Research Station, Houghton, Huntingdon.*	A Discussion on the Classification of the Avian Leucosis Complex and Fowl Paralysis.

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